Consulting Engineer

February
1957

Interview with the General

REIF J. SVERDRUP, president of Sverdrup & Parcel, Inc., consulting engineers, of St. Louis, Missouri, is a graduate of the University of Minnesota, Class of 1921. After graduation he worked for the Minnesota State Highway Department, later moving to the Missouri State Highway Department, where he became Chief Bridge Engineer and Assistant to the Chief Engineer. In 1928, he went into partnership with John I. Parcel, a professor at the University of Minnesota,

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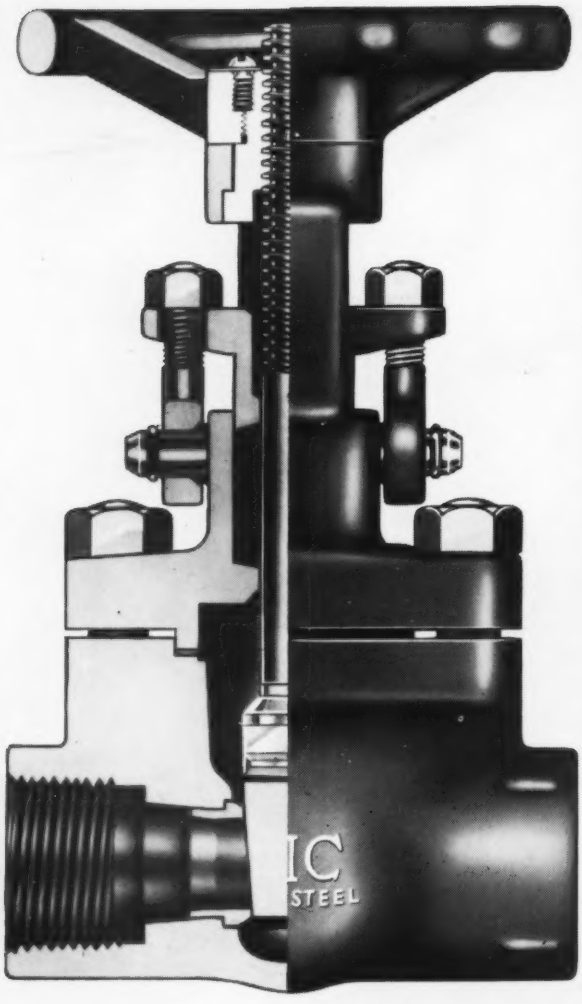
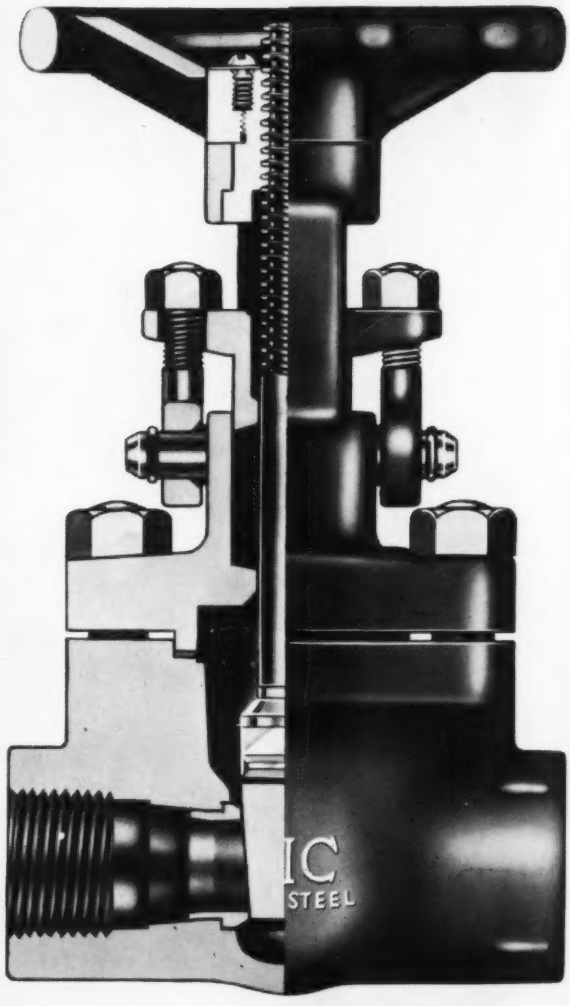
The Consulting Engineer's Professional Magazine

1100 LINE

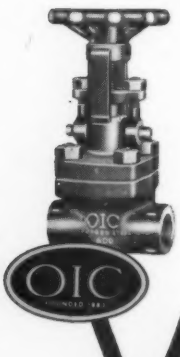


1300 LINE



New, OIC bolted bonnet, 600 lb. forged steel gate valve lines, ½" to 2" with HCH, all purpose trim.

2 new rugged OIC forged steel lines



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Consulting Engineer

February 1957

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The Consulting Engineer's Professional Magazine

L. J. Sverdrup

Continued from front cover

who had taught Sverdrup structural engineering. The present consulting engineering organization is an outgrowth of that partnership.

When World War II broke, Sverdrup was in the Pacific supervising the construction of air bases the firm had designed for the Army. He was commissioned a Colonel in the Corps of Engineers, returning to the U. S., in 1945, with the rank of Major General. During the Leyte and Luzon invasions he held the post of Acting Chief Engineer to General MacArthur's command. Later he became Commanding General of the Engineer Construction Command in the Southwest Pacific.

General Sverdrup was awarded the Distinguished Service Cross, Distinguished Service Medal, Silver Star, Legion of Merit, the Purple Heart, and four foreign decorations. Since 1947, he has commanded the 102nd Reserve Infantry Div. with headquarters in St. Louis.

Sverdrup also is a member of the American Institute of Consulting Engineers, the Society of American Military Engineers, and the American Railway Engineers Association. In 1950, he was awarded the Outstanding Achievement Medal of the University of Minnesota. In 1952, he was awarded the honorary degree of Doctor of Engineering by the University of Missouri School of Mines and Metallurgy. The General also is the Norwegian Consul for Missouri, Oklahoma, and Kansas.

The firm of Sverdrup & Parcel, Inc. has offices in St. Louis, San Francisco, and Washington, D. C. There are several subsidiary companies, and the entire organization employs over 2300 people, over half of them engineers. The parent organization, which offers a complete engineering and architectural service, has a staff of over 400 engineers.

Outside of the United States, where the situation warrants, Sverdrup and Parcel will not only act as engineers but also as constructors. It is Sverdrup's opinion that consulting engineers should stick to engineering where general contractors are available, but that where contractors with proper experience are not to be had, it is the job of the engineer to handle construction as well as design — and then to train the operating personnel. The firm has handled such package projects in the Middle and Far East, Europe, the Arctic, Central and South America, Australia, and the Islands of the Pacific. However, Sverdrup and Parcel avoid the package job where good general contractors are at hand and willing to bid.

Questions and Answers

General Sverdrup is personally familiar with overseas work in both the Western European nations and the less industrially developed nations in other parts of the world. His ideas on the operation of foreign projects are authoritative, and as a distinguished U. S. engineer, his opinions on the state of the profession in this country are worthy of consideration by his colleagues.

This interview presents Sverdrup's thoughts in those two fields:

Question — General, in your engineering activities throughout the world, how do the European engineers compare with engineers from the U. S.?

Answer — There are good and bad engineers, and many in between, all over the world. But engineers from different countries do have different characteristics. I cannot say one is better than the other, but they are different. The British, for example, used to have a number of unusual procedures. Often they would enter into joint ventures with contractors — there would be no bidding for the job — simply a matter of the engineer selecting a contractor. This type of thinking is still more common in England than here. Perhaps it has its background in the acceptance of the cartel — a sort of understanding whereby work is divided up without any need for bidding or competition of any sort. In the last few years, however, I think there has been less of this operation-by-agreement.

Q. — How about the French engineers in private practice?

A. — The French have what I call the Napoleonic concept. They make the basic line drawings; the contractor does the details. Still, this is not so bad as it sounds for either the engineer or the client. They charge much less for their services. They do a fine job on the over-all picture, then leave the details to others. On this point the British are much closer to us, the engineers supplying complete detail draw-

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The above comments are all contained in a report written by the H. M. Wilson Company, Inc., Consulting Engineers to the Central Fibre Products Company, of Quincy, Illinois. Of course, it won't hurt to get the opinion of the customer, too, if you're interested. They will be very happy to discuss their boiler installation with you.

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Below: Cross-sectional elevation of the C-E Vertical Unit Boiler, Type VU-50X, installed in the Mill Division Plant of the Central Fibre Products Company, Quincy, Illinois. There are two units, each fired with a C-E Traveling Grate Stoker and designed for the future use of oil or gas as alternate fuels.

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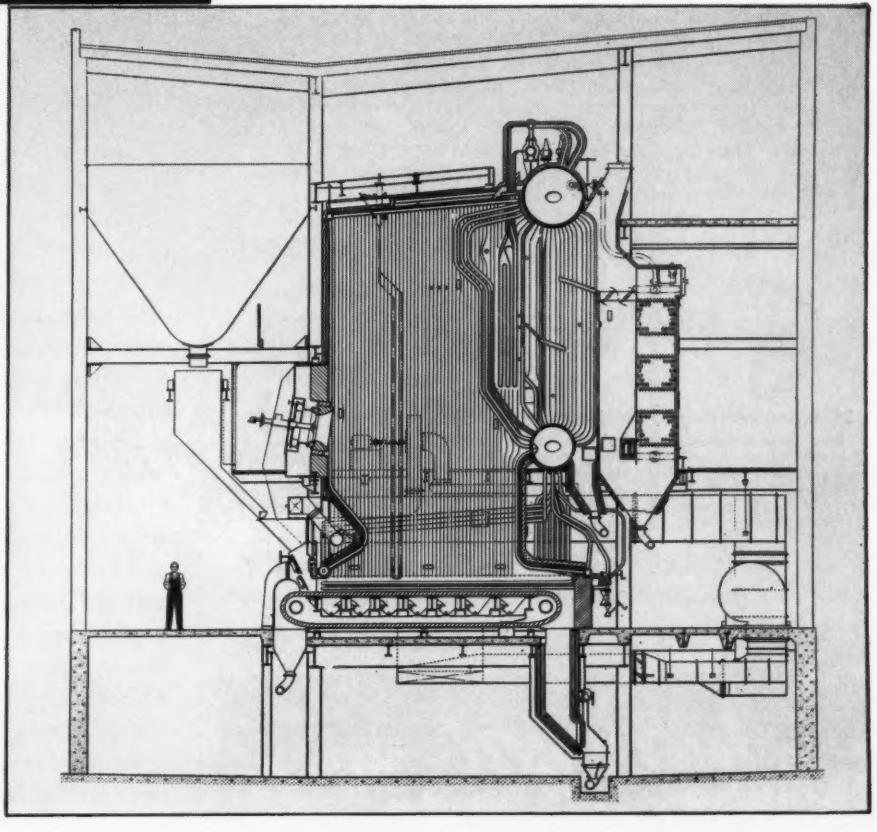
Firing aisle at the Central Fibre Products Mill Division plant at Quincy, Ill. This is a front end view of two C-E Traveling Grate Stokers which fire the VU Boilers as shown by the cross-sectional elevation drawing.



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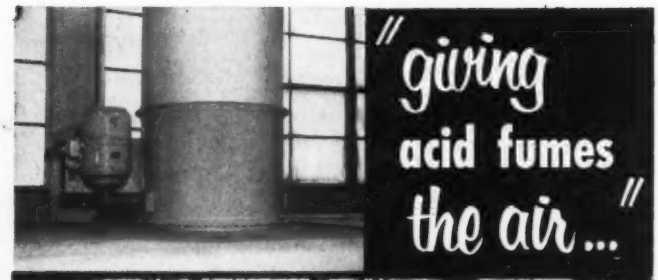
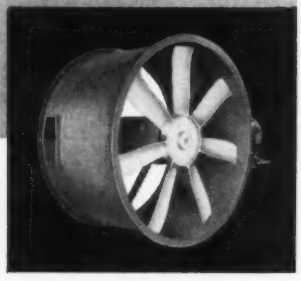


"giving acid fumes the air..."



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ings from which the contractor works. It is foolish, however, to say that French engineers, for example, are better than German engineers or that German engineers are better than the British . . . there are outstanding experts in every nation.

Q. — How are we doing in comparison with European engineers in getting foreign work?

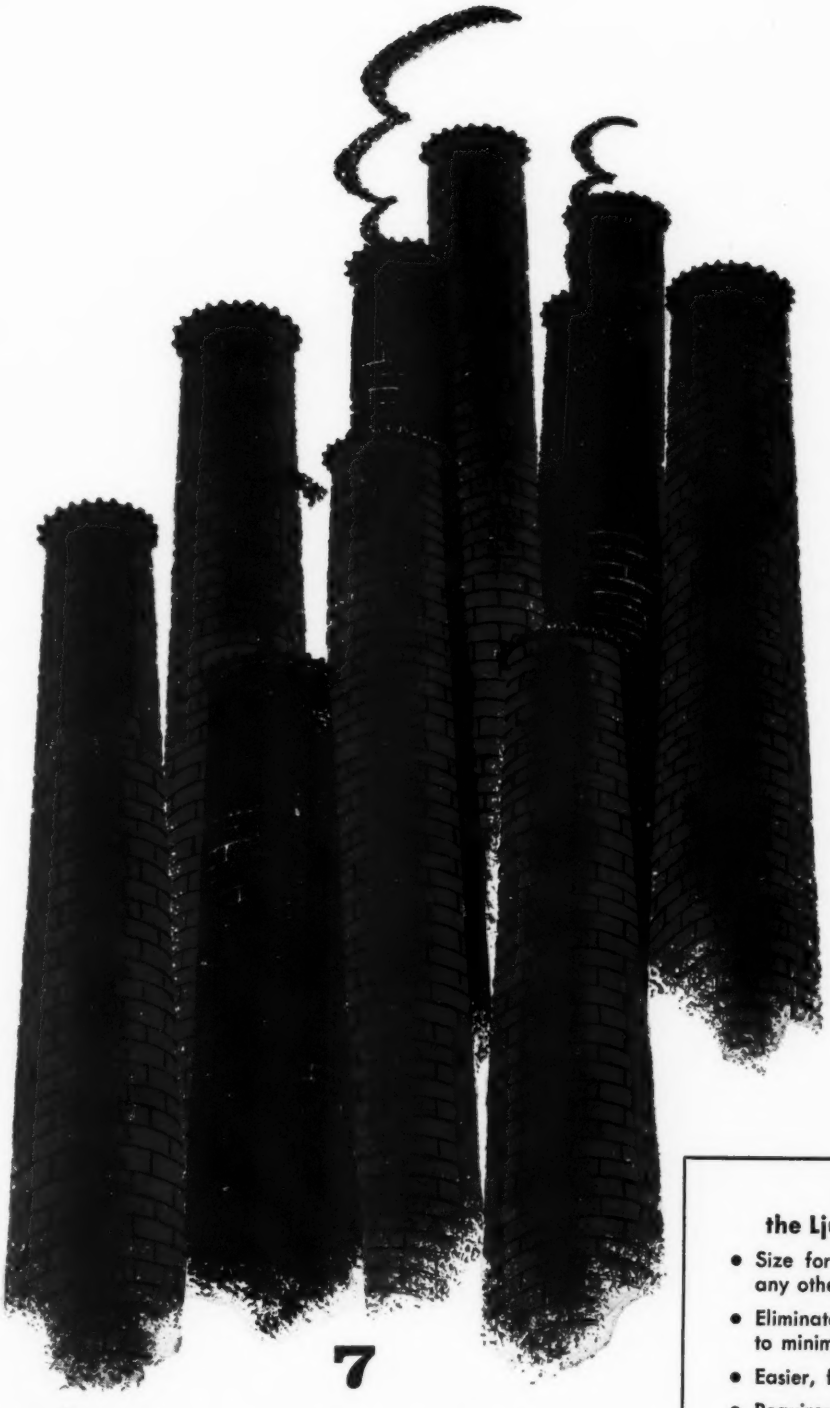
A. — Not very well. They have a number of cost advantages. Their employee wage scales are much below ours. Generally speaking, it costs less for them to travel to the foreign sites. Equally as important, the U. S. engineer is not as international in concept and does not go after foreign work unless led into it by our government.

Q. — We are busy domestically at the moment. Does it matter whether we go after foreign projects?

A. — I think it does. We need to do a great deal more work outside the U. S. We are too prone to be provincial. We need to look around and see what the rest of the world is like. Good work done abroad by good U. S. engineers is valuable to this country in a diplomatic sense. There is no question but that it is also valuable to an engineer personally to undertake foreign projects. You do not learn by confining your self to routine activities. For one thing, you find out that what works here is not always the best approach in some other land. You do not go into New Guinea and tell the native workman to build in the same manner as a Brooklyn contractor. He learns from you, but you also learn from him. Where your way is better, you train — tactfully.

Q. — If we are not getting our share of the foreign work, how can this be overcome?

A. — Despite the handicaps of our higher costs, we could be getting much more foreign work if we went after it. But more incentive is needed. We do have enough domestic work at present, and few engineers see any reason for taking the trouble to go after the distant jobs. In fact, most engineers are not too conscious of the tax advantages available to them on foreign work in the Western Hemisphere. It is possible to set up what is known as a Western Hemisphere corporation, and that type of corporation offers a tax advantage under the Federal tax laws. In other words, just as anyone can set up a Delaware, an Indiana, or a Missouri corporation, one also can establish a Western Hemisphere corporation. It does not matter whether the consulting engineer firm is under sole ownership, a partnership, or a corporation. Any of those can own a corporation, as for example, a Western Hemisphere corporation. This firm can do work anywhere in the Western Hemisphere, and as long as the work is done 90 percent outside of the United States, our income tax on that corporation is on the basis of 25 percent of profits, rather than 52 percent, as it would be in the United States. That much of a tax reduction makes foreign work in the Western Hemisphere profitable, and we can compete on a price basis with European engineers. More



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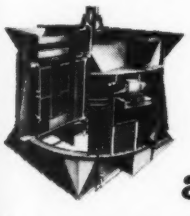

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consulting engineers should investigate that sort of thing and learn where and how they can profit by foreign work.

Q. — This Western Hemisphere corporation makes possible lower taxes on corporate profits from work done outside the U. S. and in the Western Hemisphere, but how about work in the Middle East and Asia?

A. — Unfortunately, there is no provision in the Federal tax laws for any reduction of corporate tax on work done outside the Western Hemisphere. Such a provision is badly needed. It should be possible to set up a World corporation so that U. S. engineers could work all over the World instead of just in the Western Hemisphere and have lower taxes. That is something we badly need to compete with the Europeans, and there should be some lobbying done by consulting engineers to have such a law passed.

Q. — I notice that Sverdrup and Parcel owns a number of subsidiaries. Why is that?

A. — It is simply a matter of good business. Where we can do better as a corporation, we operate as a corporation. Where we do better as a partnership, or where state laws require that consulting engineers be unincorporated, the work is done by Sverdrup & Parcel, a partnership and a separate organization. It is just a matter of sensible financial management. The first duty of any engineer is to his client. After that it is only logical that he should operate in the most economical manner to provide his organization with the greatest return for the work done. If we can keep more of our income operating as a corporation, we operate as a corporation. If we can keep more income as a partnership, then we operate as a partnership. Beyond that, if we can do better on a particular project by setting up yet another subsidiary or branch operation, we do it. Doing professional work should not mean that you need to be ignorant of good business practice.

Q. — In your overseas work in the industrially undeveloped countries have you ever gone into partnership or joint ownership with local engineers?

A. — Yes we have. We opened one office in which we shared ownership with native engineers. It worked out very well. Perhaps more of that sort of thing should be done. The native engineers know local politics and local customs and can be of great help. When your work in the area is complete, you can sell out to them, or you can retain the partnership and look for further local work. It is an excellent undertaking if properly handled. That type of thing is also of great help to the U. S. politically.

Q. — Most of the consulting firms in the U. S. are relatively small, independent operations. Does the average firm with a total staff of about 30 have much chance to do foreign work?

A. — No, not much chance. For example, the average foreign project calling for the special skills of a

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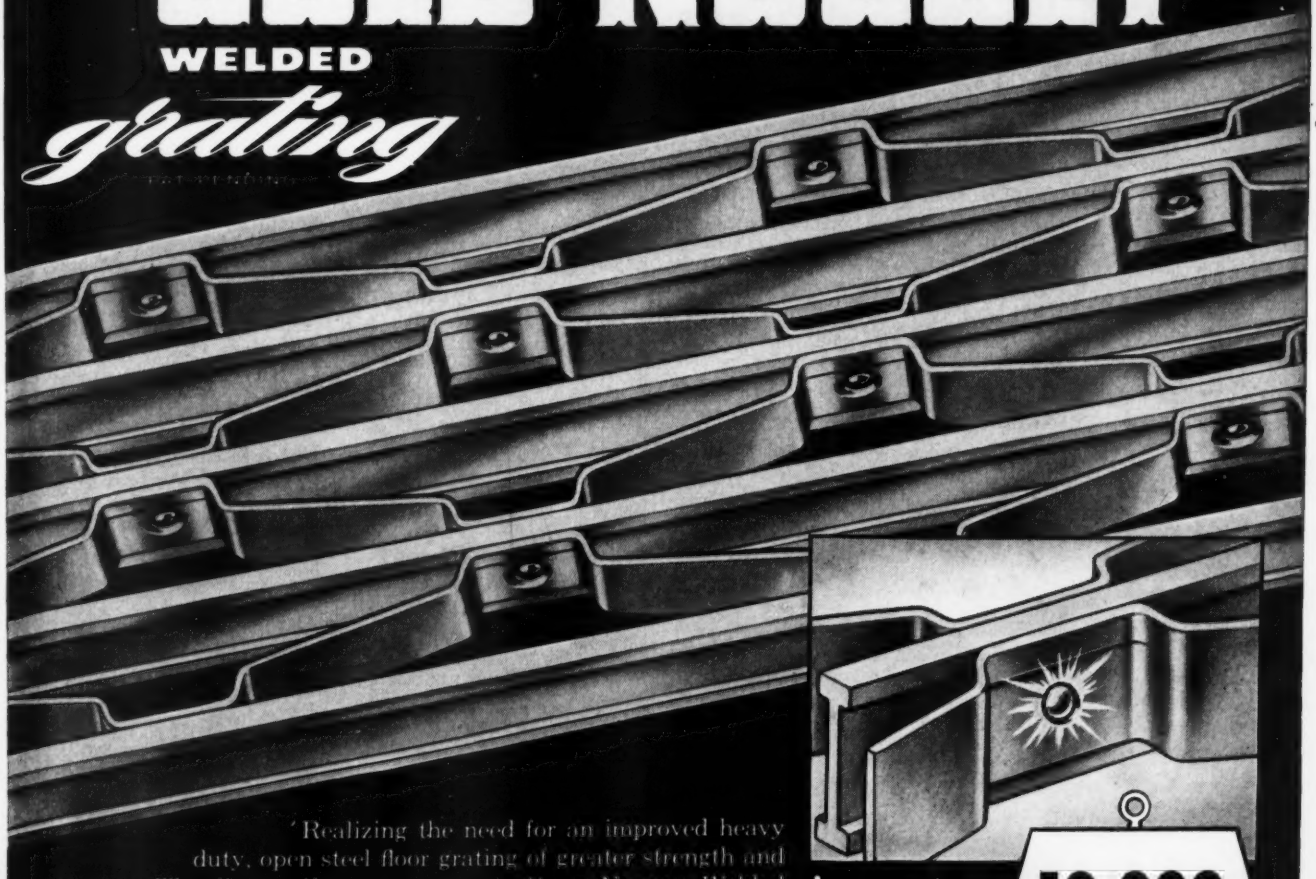

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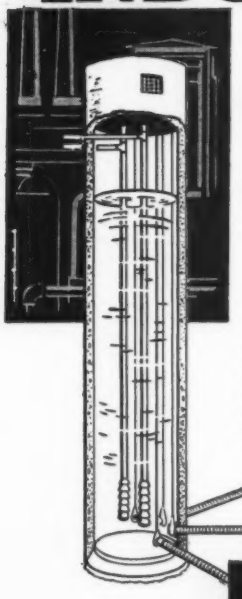

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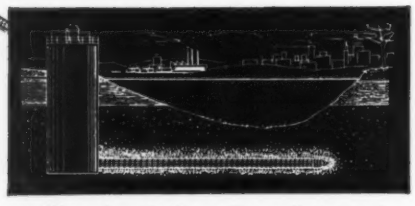

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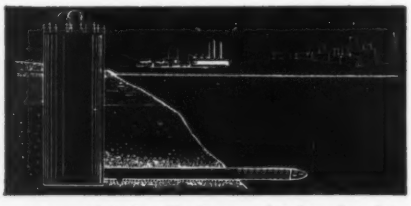

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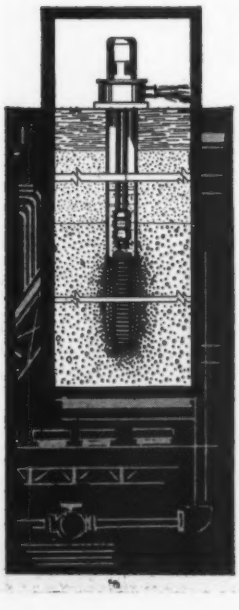

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consulting engineering firm is fairly large. It would require perhaps 60 or 70 men, and you would want at least a third of those, say 25 of them, to be old, seasoned employees. For the average firm, that would mean moving the whole organization to some foreign country and then hiring twice as many new men to go along. That is out of the question. I would think that a firm would have to have at least 100 to 200 on its regular staff before it should go out looking for foreign work.

Q. — Would it be possible for several of the smaller firms to get together in a joint venture and do foreign work?

A. — I certainly think it would. It has been done in a number of European countries, but usually under some sort of government sponsorship. We would not want the government in on it here. There is a Norwegian group that includes engineers, contractors, manufacturers, and even bankers. They all got together and offered everything necessary for work in a foreign country. I see no reason why a number of U. S. engineering firms could not go into a joint venture and offer engineering services all over the world while still operating as separate, small firms in this country. It seems to me that something of that sort might be arranged through a committee or a subgroup of the Consulting Engineers Council. However, I have always found that where real action is needed, a committee is the worst way to get it done. One really active man always can do more than a committee.

Q. — Getting back to the profession as it functions in this country, what is needed most to raise the professional status of the engineer in private practice?

A. — That is an easy question. What we need is more original work, more research. We have left too much of the research and development to the manufacturers. I know that most consulting engineers say that there is neither time nor money to do the unusual, the unique. They feel that way because they are looking at it from the wrong end. Of course there is no time to do research after you have the job. The problem at that time is to get out the drawings and specifications. There is no time to do research. Instead, the right time for research is after the job is finished. Engineers should stop acting as though the job they are on is the last one of that type they will ever do. As soon as the job is finished, put some of the men to work trying to find out how the job could have been done better. That is not very costly. We always do it. Smaller firms also can afford it. Simply assign a man or 10 men, depending on your firm size, to restudy the recently completed project, finding better ways all along the line. Then, the next time such a job comes up, the new and better ideas can be incorporated. That way there is plenty of time and little expense involved in engineering research. That is our hope for the future — the future of private practice. ▲▲

built with USS High Strength Steels

—and every month the list is growing

NOTHING SUCCEEDS like success. Less than ten years ago, the bridges built with USS high-strength, low-alloy steels could be counted on the fingers of one hand. But look around the country today and you'll find 97 major bridges that have been built with stronger, more durable USS High Strength Steels.

This phenomenal growth in the use of USS High Strength Steels is the result of an ever-increasing recognition of their advantages. Bridge engineers have found in steels like USS MAN-TEN and USS TRI-TEN "E" *superior* materials of construction with which they can (1) obtain greater strength with no increase in weight, (2) reduce weight without any sacrifice in strength, (3) insure greater durability, and (4) frequently reduce costs as well.

Here are some of the prominent bridges which have benefited by the use of USS High Strength Steel:

USS MAN-TEN STEEL

Ohio River Bridge, Wheeling, W. Va.	2,500 tons
Maumee River Bridge, Toledo, Ohio	1,913 tons
Delaware River Turnpike Bridge	11,070 tons
Red River Bridge, Shreveport, La.	2,000 tons
St. Charles Bridge, St. Charles, Mo.	3,230 tons
Penn-Lincoln Parkway Ramp, Pittsburgh, Pa.	2,300 tons
Pass Manchac Bridge, Pontchatoula, La.	1,360 tons
Inner Belt Freeway Bridge, Cleveland, Ohio	4,800 tons
Canal Bridge, Orleans Parish, La.	1,635 tons

USS TRI-TEN "E" STEEL

Columbia River Bridge, Umatilla, Ore.	1,864 tons
Paseo Bridge, Kansas City, Mo.	3,759 tons
Ohio River Bridge, Shawneetown, Ill.	2,295 tons
Missouri River Bridge, Jefferson City, Mo.	1,692 tons
Kansas Turnpike Bridge	1,800 tons
Missouri River Bridge, Kansas City, Mo.	1,525 tons

We think this list, though far from complete, speaks for itself. Significant, too, is the fact that USS High Strength Steels are being specified for many of the major bridges projected for the immediate future.

We will be glad to discuss with you how these superior structural steels can be incorporated into your designs to provide maximum strength, safety and durability with a minimum of weight and cost.

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USS HIGH STRENGTH STEELS 1933 1957 24 YEARS OF PERFORMANCE

UNITED STATES STEEL

The Reader's Guide

How to Avoid Equality

When you run into a Russian engineer, don't expect that he will be some poor, downtrodden, educated slob. He may be educated, and he may be a slob, but it is not likely that he will be downtrodden. Engineers in Russia are in the top echelon. According to this month's "Report from Russia," page 121, as prepared for CONSULTING ENGINEER by A. J. Steiger, the Russian engineer is well paid even when he does straight engineering work (up to about $18,000 a year as compared to about $2500 for the average worker). If he becomes the executive director of an industrial plant — and many such directors are engineers — he can make $36,000 a year, and he gets a house and chauffeur driven car thrown in — all without taxes. No wonder everyone in Russia is studying engineering. It is the best way to avoid being "equal."

Technical Progress and Legislation

Russia is not the only place where politics affects engineers and engineering progress. England had such a situation in the 1880's, when there was a great political rhubarb over ownership of gas utilities and the just a'borning electric industry. Here in the United States the early promoters of electric power faced only the natural economic and technical problems common to any new undertaking, but in England, Parliament was developing a taste for social legislation and public ownership. There was also a powerful gas lobby that could see nothing bright about a future lighted by electric lamps. Parliament proceeded to impose restrictions that retarded the growth of electric utilities to such an extent that England fell far behind the U.S. in this field. Dr. Thomas Hughes, Professor of History at Washington and Lee University, tells the story of that struggle between lawmakers and engineers in his article, "The Law that Dimmed the Lights," on page 98.

Legislation and the Atom

We might learn much from English history of the last century, for today we face a somewhat similar situation with regard to nuclear energy for power. The Atomic Energy Act of 1954 permits the AEC to license private groups to build atomic power plants, yet reserves the right for the government, itself, to build and operate plants in competition with private enterprise. This month, Melvin Nord, in his "Legal Aspects" column begins an explanation of the laws controlling the use of nuclear energy. As he points out (page 50) this is a field in which consulting engineers are playing an increasingly important role. We must keep an eye on legislation to be sure we are not delayed more by law than by lack of technical knowledge.

Tall Buildings Built of Brick

The Swiss are not only fine people but they have produced great engineers. They are recognized all over the world for their mechanical and electrical genius, but they also have done some excellent civil and structural work. Jakob Schneider, of Bern, is a jovial man with an excellent engineering mind. He has been, for several years, a strong proponent of brick as a modern structural material. This month, he will see three, 13-story brick buildings of his design completed in his own city. He prepared for us an interesting article, "How We Design High Brick Buildings," published on page 72, in which he describes the design work required for brick structures and supplies detailed plans to illustrate his methods. As to cost, his brick designs are competitive with reinforced concrete — in Switzerland, at least.

INSULATED METAL WALLS

for INDUSTRIAL and COMMERCIAL BUILDINGS

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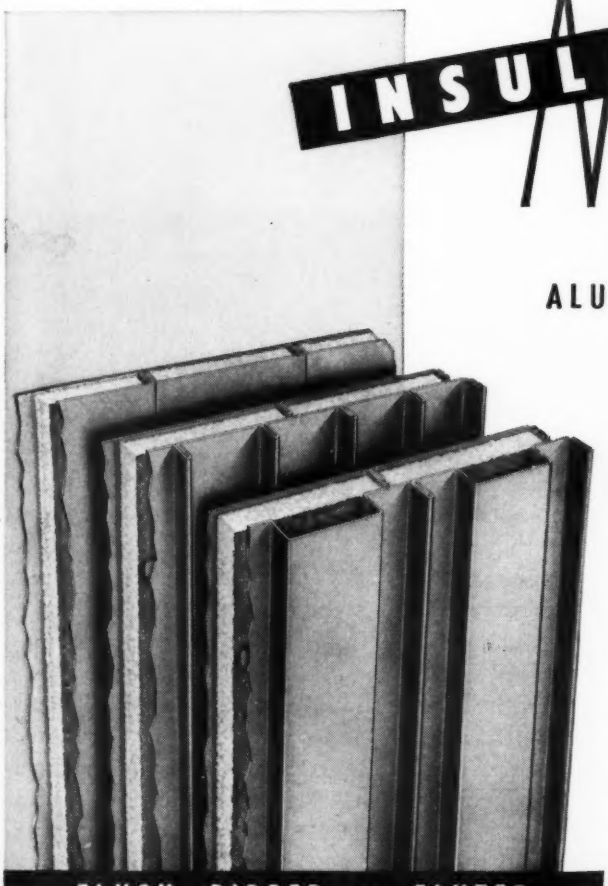

FLUSH, RIBBED, or FLUTED

Over-all "U" Factor is Superior to a Conventional Masonry Wall with Furred Lath and Plaster

In recent years, architects have employed Mahon Insulated Metal Curtain Walls skillfully and to good advantage, costwise, in producing some outstanding design effects in buildings of virtually every type—including some monumental buildings. Bright metal—aluminum or stainless steel—in combination with brick, ornamental stone, glass block or other materials, offers unlimited possibilities in architectural treatment of exterior design. The building below is an excellent example. Mahon Insulated Metal Curtain Walls are light weight, permanent construction. Erection is fast . . . buildings can be quickly enclosed with metal curtain walls—even under low temperature conditions. They are economical, too . . . savings amount to as much as 50% of the cost of masonry walls in some types of buildings. Mahon walls are available in the three patterns shown at left. In the "Fluted Wall" and the "Ribbed Wall", vertical joints are invisible—symmetry of pattern is uninterrupted across the wall surface . . . and, both of these walls can be erected up to sixty feet in height without a horizontal joint. These two design features—extremely important, particularly in powerhouses and other buildings where high expanses of unbroken wall surface are common—were engineered into Mahon Insulated Metal Walls to give you a finer appearing job free from unsightly joints. You'll want these "better look" features in the wall you select for your next building. See Sweet's Files for information, or write for Catalog W-57.

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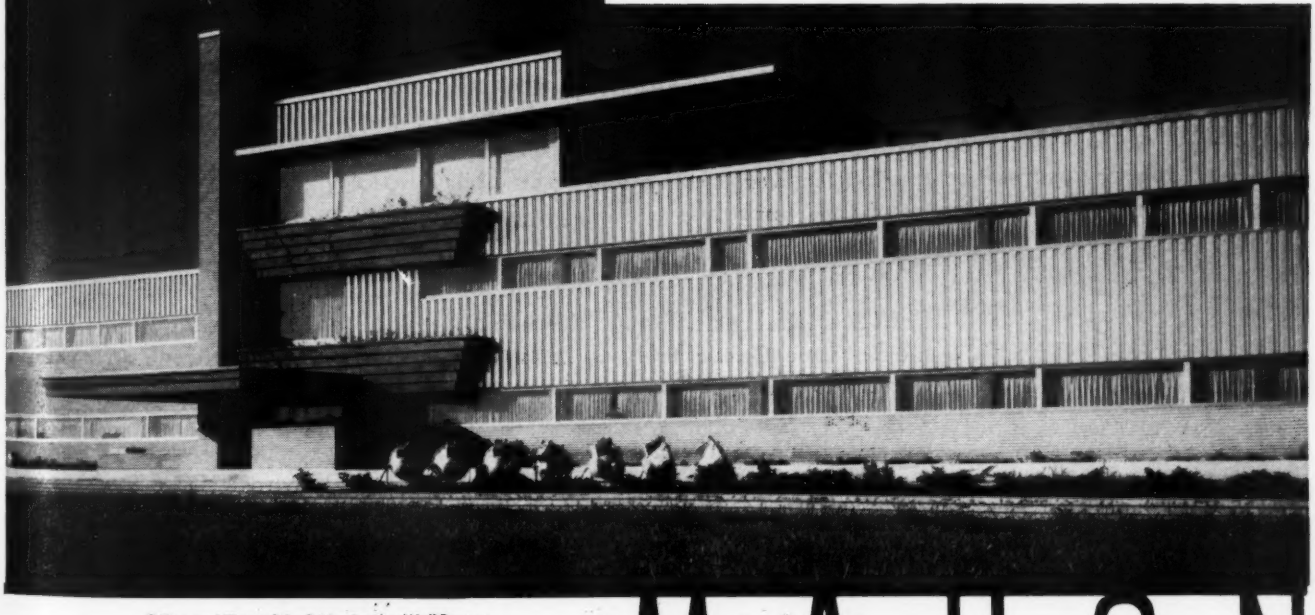
Manufacturers of Insulated Metal Curtain Walls; Steel Roof Deck and Long Span M-Decks Acoustical and Troffer Forms; Electrified M-Floors; Rolling Steel Doors, Grilles, and Underwriters' Labeled Rolling Steel Fire Doors and Fire Shutters.



Office and Plant of the Schlumberger Well Survey Corporation, Houston, Texas. 20,000 sq. ft. of Mahon Aluminum Curtain Walls were employed in this project. Mackie & Kamrath, Architects. Tellepsen Construction Co., General Contractors.

MAHON

Prestressed Concrete

While Switzerland turns from concrete to brick, we, here in the U.S., are beginning to use prestressed concrete, a European concept, in a big way. C. L. Bankston, Jr., a young engineer in George Heft's office, in New Orleans, has made a thorough study of prestressed concrete design and has prepared a practical article that will give the U. S. consultant a clear picture of when and where prestressing is logical and economical. After a general discussion of design, he gives an example of calculations and decisions made in connection with design of the Wisner Overpass project, in New Orleans. The article, "Prestressed Concrete Designs," on page 86, is well worth a careful reading.

Corporate Practice

Part I of the "Survey of the Profession — 1957" published last month, showed that there is a steady increase in the number of consulting firms operating as corporations. This trend is not looked upon with favor by many engineers, who claim that a profession can only be practiced by a person, not by a corporation. This problem is far from settled, but James P. O'Donnell, a consulting engineer, (unincorporated) with offices in New York City and Beaumont, Texas, has a number of reasons for thinking that engineers should not operate under a corporate structure. O'Donnell is chairman of the Joint Professional Committee for Study of the Education Law (New York's Registration Law) and a member of NYSSPE's Ethical Practices and State Legislative Committees. He has made a thorough study of the subject, and his article, "We Oppose Corporate Practice," starting on page 109 condenses a lot of thought into a little space.

The Survey Continues

Parts II and III of the "Survey of the Profession — 1957" are published as a staff prepared article (page 77) telling consulting engineers a lot more about themselves. If you complained about the time and effort it took to fill out the individual questionnaires, your complaints were mild in comparison with the screams that arose from the offices in which the computations were made for a 1000-unit sample. But the results were worth it. Now, every consultant can know a lot more about his own profession. How many consultants also do contracting? How many offer architectural services? What percentage of the engineers in private practice are mechanical, electrical, civil, or chemical? What is the average engineer's geographical range? Does he rent his office or own it? Is he located downtown or in the suburbs? Answers to these and many other questions are given in this installment of the "Survey."

His Gain is Our Loss

E. F. MacDonald's column, "Economic News Notes" appears in this issue for the last time. This is truly an instance in which parting is "sweet sorrow" for Mr. MacDonald is giving up the column for a very pleasant reason. He has been promoted. On the first of the year he was made an officer of the Federal Reserve Bank of Richmond. He has to stop writing for us because the Federal Reserve Bank has some sort of rule about their officers writing for publications. As long as Mac was a mere employee, and no mention was made of his connection with the Bank, he was free to write and say what he pleased, but officers are different. Whatever they say is supposed to represent the official opinion of the bank. We are going to miss Mac's column. He was our first columnist. "Economic News Notes" appeared in the first regular issue of CONSULTING ENGINEER, in March 1953. When MacDonald wrote us to explain that he had been promoted to officer rank, he failed to say exactly what his new title would be. We hope they made him president, at least.

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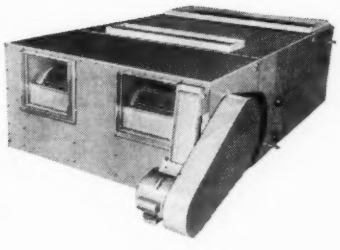
Heating, Ventilating and Cooling Units that change their own filters



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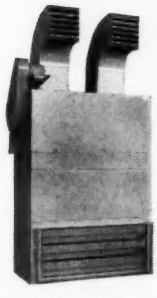

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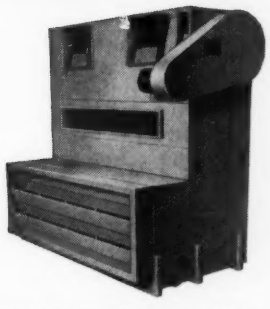

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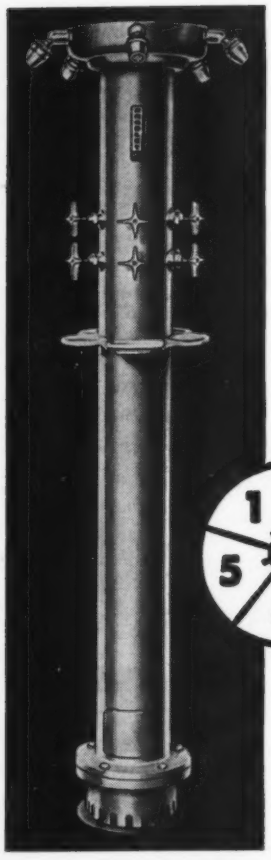

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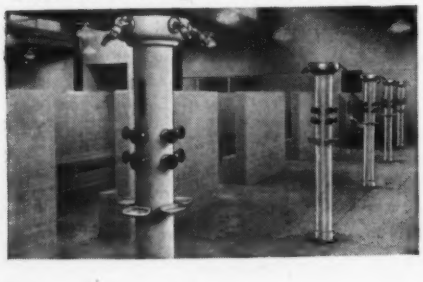

National Engineers' Week

Sir:

Every year you seem to studiously avoid any mention of National Engineers' Week. This year it will be from Feb. 17-23.

How about a little plug this year? Eleven of America's top engineers are sponsors. Complete dope is available from NSPE, 2029 K St., N. W., Washington 6, D.C.

E. G. Lowell, P.E.
Pasadena, Calif.

Public Relations

Sir:

The editorial on page 24 of the January issue of CONSULTING ENGINEER relating to Public Relations was in my opinion a job well done. My congratulations. What more can I say?

Pecos H. Calahan, Exec. Sec.
Consulting Engineers
Association of Calif.
San Francisco, Calif.

Sir:

We should like to disagree — agreeably, we hope — with some of the statements made in "Scraps and Shavings" in the January issue.

1 — The practitioners of the art (of public relations) *are* able to define it, in several ways as a matter of fact. The one we like best: "Doing the right thing and getting credit for it."

2 — We quote: "Even public construction is of little concern to the public . . . "This suggests that the writer has never been to a School Board meeting, or has never been involved in the inevitable hassle which evolves when a community needs a new school. We went through this three times recently, in Thornwood (N.Y.), and nobody ever needed good PR counsel worse than our architect. It was only after the citizens themselves took matters in hand that the bond issue was finally, after two years, put across.

3 — "... if every man knew all about consulting engineers ... it would have little effect on the consultant's income or his professional position." Quite the contrary, the only way the engineering profession can gain any stature or prestige (and that means more income, too) is for the public to be educated to the value of the engineer in our society. Who builds the bridges, the power plants? Who designs the washing machines, the cars, the printing presses? Who has made TV possible? True, many developments are by company engineering staffs, but no doubt an equally large number are the work of consulting engineering firms, retained to complete a specific task.

4 — "The rest of the public may well follow Mr. Vanderbilt's suggestion." Do you *really* mean "the public be dammed"? If so, we're aghast that this 19th century attitude should still find supporters. Also, it implies a certain snobbish attitude of which our engineering profession has often been accused—apparently with some justification.

5 — In one of the next paragraphs, the terms "public relations," "publicity," and "advertising" are used interchangeably; yet, they are by no means synonymous. Public relations is a broad effort — defined once before — aimed at stockholders, financial departments, employees, and the local community, in an attempt to present the company in its best light. Publicity is but *one* of the tools with which to accomplish this; there are others. Advertising, as you must know, is the purchase of space (or

If you are ever going to need an

OVERHEAD CRANE . . .

you need this book, now!

Before you take the first step in planning your next overhead-crane purchase, you owe it to yourself and your firm to protect that "big-ticket" *lifetime* investment by reading this booklet, "How to Evaluate Crane Bids." Don't wait until the specifications are drawn up. Accurate guidance from the first planning stages will help insure the best return from your crane investment.

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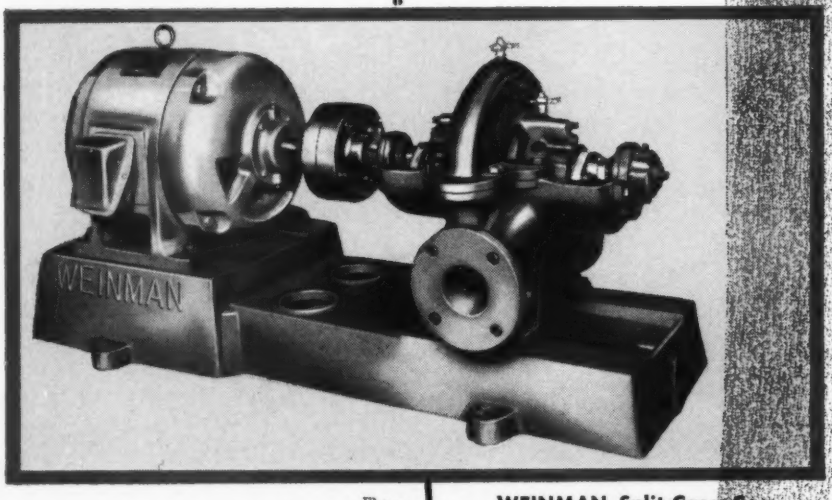
Send for this free booklet, now. Write Dept. 101F Industrial Division, Harnischfeger Corp., Milwaukee 46, Wisconsin.

PULL THE AXLE TO FIX A FLAT?

Pretty ridiculous suggestion, isn't it? Yet, many plants are faced with a similar situation when pumps fail. Piping must be removed, fittings and connections dismantled, the driver disconnected . . . all to repair the pump!

You can reduce such costly downtime with WEINMAN Horizontally Split-Case Centrifugal Pumps. First, these pumps seldom require maintenance or repair, because they're built for rugged, long-range dependability. Second, they're pre-engineered to eliminate prolonged shut-down in those rare instances when repair or maintenance is necessary. The upper half of the casing opens for quick inspections, and even quicker repair. You never need to disturb piping, connections, fittings or the driver.



Save money with WEINMAN Split-Case Centrifugal Pumps . . . they cost less initially, less in the long-run. Your nearest WEINMAN Specialist will be glad to help you solve any pump problem. He's listed in the yellow pages of your phone book . . . call him any time, he's a good man to know.

WEINMAN Split-Case Centrifugal Pumps are furnished in bronze, cast-iron or special alloy metals. Capacities up to 5,000 gpm.

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time) in which to say anything you want, within the limits of decorum, at exactly the moment you wish to say it. As for "deer hunting with a rifle . . . " we can only say that we once threw a hand-grenade into a little stream, and caught more fish, in one minute, than we would have in a day with rod and reel.

6 — Again, we quote: "Consulting engineer associations . . . must . . . aim at architects and potential clients." What shall this aim be? What is the association selling? Who are the *clients* of an *association?*

You probably won't believe this — but we agree with the last two paragraphs of the editorial.

Lucien R. Greif
Greif-Associates, Inc.
New York, N. Y.

For Your Library

Sir:

I always read with interest and profit your splendid magazine. In the December 1956 issue you presented us with a most practical list of books for our libraries, but you seem to have somewhat overlooked the most practical and easily understood book on soils and foundations.

Foundation soils present a real problem for nearly all engineers today, who are called upon to plan and build foundations for heavy machines, storage buildings, power plants, as well as highways and airports. Many of these consultants do not have a soil engineer on their staff. The designing engineers find it hard to understand the factors in soils which determine the design for today's economically constructed foundations.

The college textbook *Introductory Soil Mechanics and Foundations* by Sowers & Sowers, published by The Macmillan Company of New York, is just the kind of simple soil and foundation book that every engineering library should have available for the reference use of designing engineers who have not had a college training on this rather new yet very old subject. It is small and the text is in simple language easily understood by engineers. More than twenty-five universities in this country are now using this book in their undergraduate courses in civil engineering.

George B. Sowers
Consulting Engineer
Cleveland, Ohio

Sir:

We read with interest the article on "Building An Engineering Library" in the December issue. These

push-button material flow

Airstream Conveyors permit close integration of bulk handling with production

If your project requires the integration of dry bulk materials handling with production, you should consider the many advantages offered by Dracco Airstream Conveyors.

Airstream Conveyors are readily adaptable to control. Any degree of automation is possible—one man at a centralized panel can control all phases of even the most complex handling system. Movement of materials is smooth and swift—processes are tied together into a single coordinated operation with no waste motion.

Airstream Conveyors can perform a wide range of bulk handling functions: (1) moving raw materials from transport to storage and from storage to process; (2) moving intermediate stage materials from process to process; and (3) moving the finished product from end of process to packaging or bulkloading. In addition, materials enroute from point to point may be weighed, batched or blended without halting flow.

Airstream Conveyors can handle any dry bulk powdered or granular material at almost any desired handling rate. They are completely enclosed, sanitary, self-cleaning, dust-free and easy to maintain. To find out more details on how Airstream Conveyors can be integrated with production, call or write Dracco today.

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Dracco Bulletin 529, "Airstream Conveyors", contains detailed information on equipment and uses. Shows examples. For your copy, write Dracco today.

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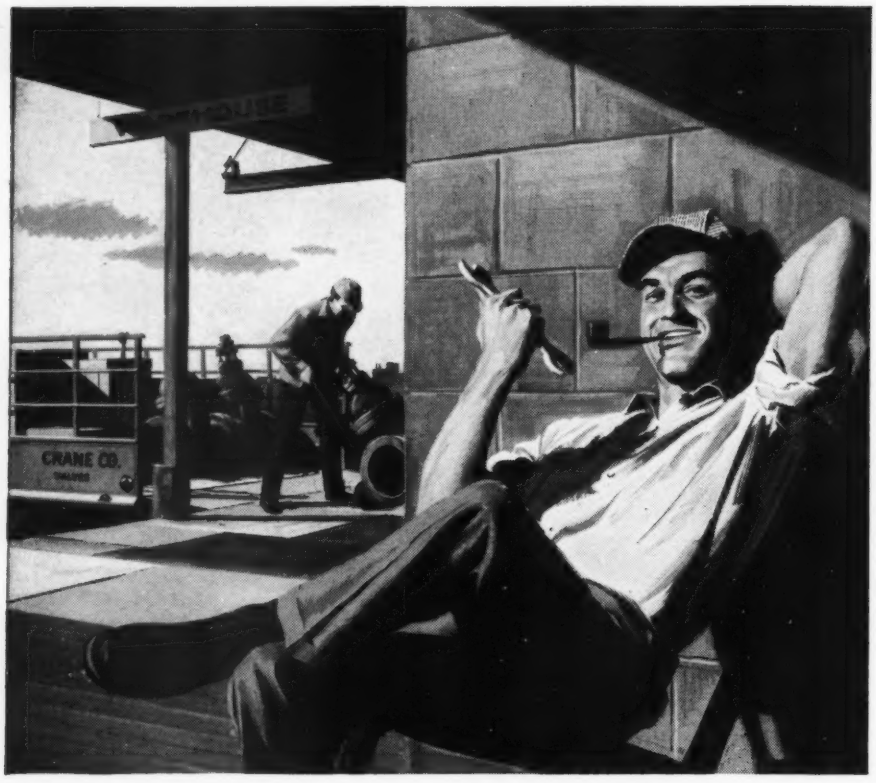

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Everywhere these new Crane AWWA Valves have been installed, maintenance costs have dropped. Here are some reasons why:

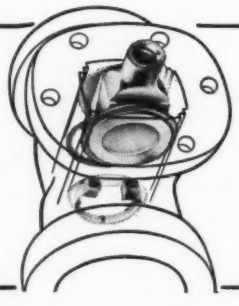
The design of the Crane 4-piece disc assembly and guide ribs permits the trunnion-mounted twin discs to rotate freely as they are raised or lowered. Concentrated wear on both seats and discs is prevented. The simplified wedging action assures positive seating . . . tight closing. And the guide ribs prevent the disc assembly from jamming or disengaging.

Crane AWWA Valves meet all AWWA specifications. You also get the Crane 2-piece gland and gland flange with ball-type bearing. Prevents binding on stem under uneven pull-up on gland bolts.

You can order Crane AWWA Valves with hub, flanged or mechanical joint ends—in sizes 2" to 12". For complete specifications, contact your local Crane Representative, or write to the address below.

View of disc assembly showing its simplicity. Assembly is suspended from stem, which engages upper spreader. Discs are suspended from upper spreader on trunnions. Disc flange guides hold assembly between guide ribs.

These valves available with hub, flanged, or mechanical joint ends.



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articles on general office operation provide good ideas which many of us small consultants as well as the larger firms will find of value.

Donald E. French
Donald E. French and Associates
Kahoka, Mo.

Final Burial

Sir:

Under "Reader's Comment" in the January 1957 issue of CONSULTING ENGINEER, Mr. A. E. Knowlton, Editor-in-Chief of the Standard Handbook for Electrical Engineers, refers to the spelling of burial on page 26 of the December issue.

We cannot find the word on page 26 but on page 28 under "Atoms in Action."

Who goofed again?

"What's Come To Perfection Perishes . . . . . "

Earl M. DeNoon, P. E.
Owner & Tech. Dir.
South Florida Test Service
Miami, Fla.

• MR. KNOWLTON'S LETTER WAS REPRINTED ACCURATELY, COMMA FOR COMMA, WORD FOR WORD.

Definition from Oregon

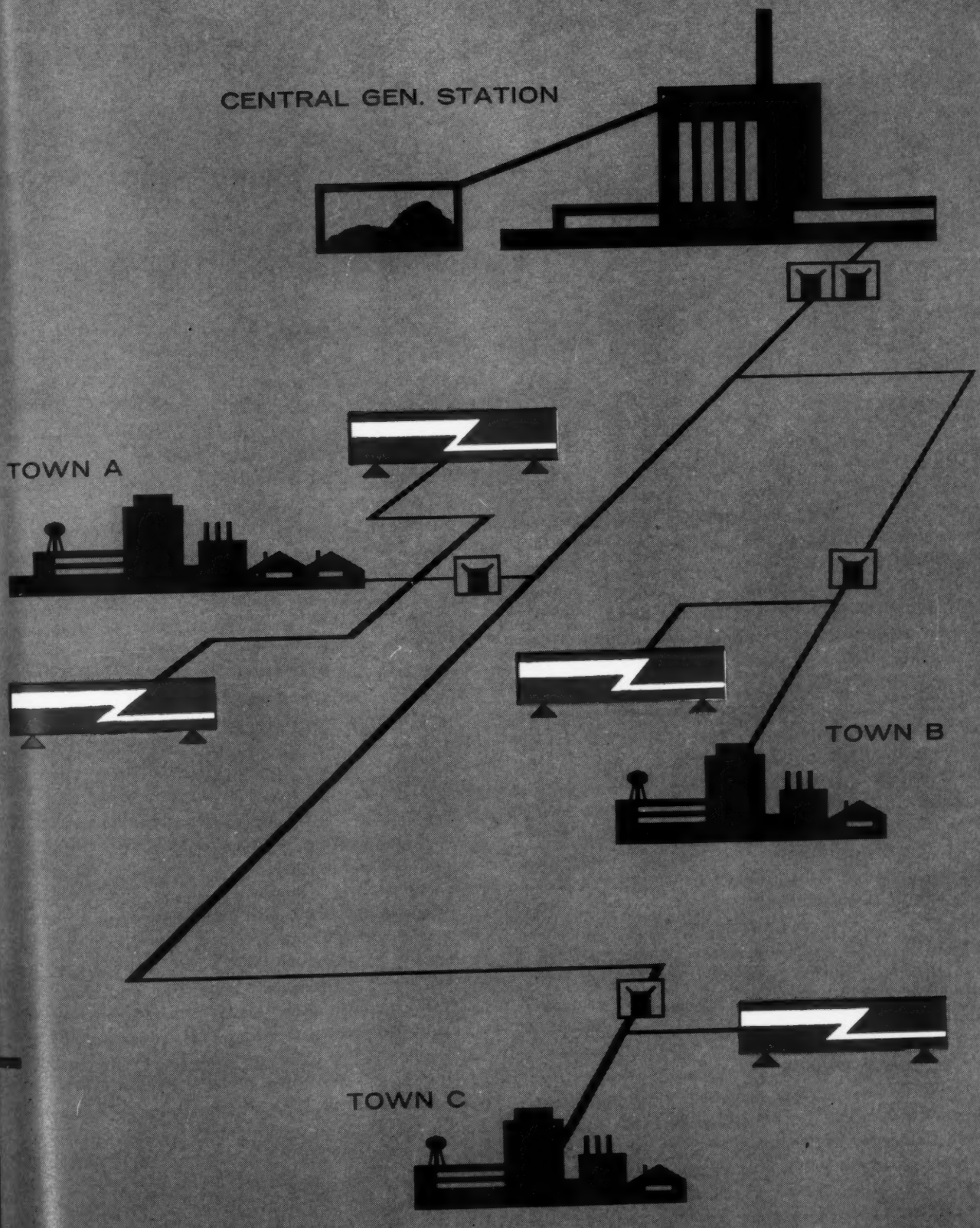
Sir:

"Scraps & Shavings" in your December issue suggest to me that you may wish a copy of the Constitution of CEAO (Consulting Engineers Association of Oregon), ratified last month . . . This Constitution, we feel, is not restrictive in the sense discussed under Scraps & Shavings. Also, under Article II, Membership, you will notice that we felt it was essential to define a consulting engineer, which we have attempted to do.

Our definition is:

"The practice of consulting engineering is defined as the act of rendering counsel and service by a registered professional engineer to a client who has retained the engineer on a fee basis. The engineer shall act as a free agent and bring to the client the highest quality of service by reason of his special training, broad experience, proven ability, and professional integrity. He shall act without prejudice and his judgment shall not be biased by monetary interest in the materials, equipment, or construction forces with which he works. His actions shall be in accord with the code of ethics of this Association."

J. Donald Kroeker, President
Consulting Engineers
Association of Oregon
Portland, Oregon



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Well, God give them wisdom that have it; and those that are fools, let them use their talents.

(Twelfth Night)

IT SEEMS LIKELY that many engineers in private practice are spending too high a percentage of their time on routine technical work and too little time on original design and on the business aspects of the profession. We have seen excellent engineers, men who should be putting their mind to basic concepts and to top management problems, sitting at a drafting table or at a desk compiling data that could be calculated by a well trained dog.

An engineer has too much of a tendency to do every detail himself because he thinks that he is the only person who never makes mistakes. If he intrusts the addition of a column of two-digit figures to an assistant, he goes back to the office at night and adds them over just to make sure.

No reasonable person can criticize a desire for accuracy, particularly in engineering work, but Harlow Curtice cannot take the time to check, personally, the ash trays in every Chevrolet leaving the plant. He must assign at least part of the ash tray inspection to someone else.

This way of doing things can seriously endanger the growth of a consulting firm. It takes subtile forms. For example, the owner of a firm of engineers in the Midwest, a firm working primarily on highway work, stated that he could not use technicians; even the lowest job in his firm had to be filled by a graduate engineer. That is, of course, sheer nonsense. It does take an engineer to carry a project or a portion of a project from inception through to completion, but every experienced engineer knows that any type of engineering, certainly highway engineering with all of its cut and fill calculations, involves hours of work that can be done better by a comptometer operator than by a graduate engineer.

To some extent pride is responsible. The engineer hates to admit that any part of his work requires anything less than genius. A part of his work actually does require genius. As much of his time as possible should be given to that part.

This problem is particularly acute in connection with drafting. Some of the best engineers in the country insist that detailed drafting must be done by professional engineers rather than by draftsmen. There is no doubt that some board work requires engineering talent, and there is no doubt that a good engineer needs drafting ability, but it is both laughable and pitiful to watch a top-flight engineer sitting at a drafting board drawing, repetitiously, thousands of small circles to represent rivet heads. Engineers can spend their time in better ways.

Is it not strange that the engineer, the very symbol of material progress and efficiency, does not yet know how to apply properly his own valuable time. In a few of the large engineering organizations one does find the top men devoting their time and thought to worthy activities. One wonders if this proper assignment of work is possible only in large firms or if, perhaps, these firms are large and successful because someone understood the need for freeing good men from routine detail.

Is it not strange, also, that the engineer can go to a client and tell him just how he can make use of new methods that save time and money, but in his own engineering office he makes use of a manual adding machine and a slide rule for calculations that could be done on modern business machines in a tenth, perhaps a hundredth, of the time. This wasted time is charged to the job, and the client pays for it. Yet the engineer complains that he is always too rushed and is grossly underpaid.

The engineer must learn to communicate his ideas to the technicians and let them handle the details. He must learn to delegate minor tasks to employees down the line. He must make use of new office machinery — relatively inexpensive equipment that can solve in seconds equations that take hours by hands and head. These steps are essential if the engineer's genius is to be free for original work.

The engineer in private practice has yet another problem. Not only is he an engineer but he must be a good business man or he will not long be an engineer. He must attend to client relations (and this takes genius of a sort), he must be something of a cost accountant, and he must see to it that his office runs efficiently.

Private practice requires wisdom rather than talent, and the man that has wisdom cannot afford to waste it doing only that which lesser men can do better. ▲▲

PANEL OF PIONEER Prefabricators Cite These Outstanding Prestressed Concrete Advantages...

1. Fully Utilizes Two Inherent Strength Factors

Prestressing combines and enhances the inherent characteristics of two of the foremost construction materials—

A. The compression strength of concrete with

B. The high tensile strength of stress relieved cold drawn steel wire and strand.

2. Basic Economy

A. Steel for prestressing is six times stronger than ordinary steel but only approximately 3 times more costly.

B. Concrete for prestressing is twice as strong but only 10 to 20% more costly than ordinary concrete.

C. Prestressing consumes less steel and concrete to attain equal or greater structural strength more economically.

3. Structural Balance

A. In prestressed concrete, stresses and strains are balanced to produce structures whose deflections are under definite control.

B. Cracks, otherwise unavoidable in concrete, are eliminated by prestressing.

4. Design Economy

A. Prestressed concrete makes possible thinner sections, lower depth to span ratios, longer cantilevering without ballast beams and reduction in weight. All of these factors enable the designer to effect savings in foundation, in columns, in wall height or to convert head room into usable cubage.

B. Steady progress in standardization of sections under the auspices of the Prestressed Concrete Institute is making prestressed concrete more and more versatile from the standpoint of designers.

5. Prestressing Is Pre-Testing

A. Because they are subjected to greater loads in fabrication than is imposed upon them in the field, precast, prestressed members are in reality pretested.

B. Produced by factory methods, under closely controlled conditions, prestressed concrete guarantees the designer structural performance to meet or better expectations and affords relief from extensive supervision and inspections.

6. Stock Pile Availability

A. Factory line production methods with time saving devices insures delivery of prestressed concrete members from the production line in step with contractors work schedules.

B. Production of prestressed sections proceeds at top speed, affording maximum utilization of labor and stockpiling against projected construction.

C. Prestressed concrete eliminates construction delays by by-passing materials in short supply or on extended backlog delivery.

7. Speeds Up Construction

A. Construction by the older, conventional methods involves both erection and fabrication on the job site.

B. The latter is accomplished much faster in central plants or on the site mechanized plants and the resulting prefabricated units are erected with clock-like precision.

C. Often it is possible to complete structures in half the time required by conventional methods. It is often possible to erect prestressed concrete in the time required to make, place and shore up forms for poured in place concrete.

8. Permanence of Concrete—Plus

A. Well known is the durability of concrete. Well known too is its vulnerability to cracking. Cracks lay it and its reinforcing open to deterioration.

B. Prestressing makes concrete a flexible material with the ability to withstand extraordinary deflection and recover without cracking.

9. Insurance Savings

Comparison of insurance premiums are reported on new buildings with prestressed concrete roofs as against old buildings with wood roofs. Roughly the yearly premium on the latter is more than for 5 years on buildings with prestressed roofs. Though this is a comparison of extremes, it is indicative of how prestressed construction is regarded by insurance companies.

10. Economy of Maintenance

A. Even in marine construction or in construction subjected to other extreme corrosive conditions, the cost of maintenance on prestressed concrete construction ranges from nil to the expense involved in painting in cases where color is desired.

11. Widely Competitive

A. The initial cost of prestressed concrete is such as to enable its prefabricators to successfully bid against the permanent, fire resistant, all-weather types of construction in many types of structures.

B. When the collateral economies effected by prestressed concrete, such as greater and more flexible strength for longer spans and fewer columns, balanced stresses and strains and controlled deflection, thinner sections, lower depth to span ratios, lower wall heights and increased usable cubage, ready availability, speedier erection, negligible maintenance and lower insurance premiums are considered, then the competitive edge is definitely on the side of prestressed concrete for a growing list of structures.

So goes the summary of the thoughts of a panel of pioneers except for a warning which was sounded: Be sure of adequate capital and technical guidance when venturing into the business.

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ATOMS IN ACTION

AIMING at the school market, American-Standard and Daystrom, Inc. plan to build and sell research reactors designed specifically to fill the needs of colleges and universities for a reactor to use in the training of nuclear engineering students. Design is similar to that of the Argonaut, developed by AEC's Argonne National Laboratory. Daystrom has applied to AEC for a permit to build its first Argonaut in New Jersey, with construction to begin early this year. American-Standard hopes to complete its Argonaut, in Redwood City, Calif., for the fall semester.

GENERAL ELECTRIC'S Atomic Power Equipment Department has available a technical bulletin describing characteristics and uses of three research reactors: swimming pool, heavy water, and nuclear test reactors. For a copy write to General Electric Apparatus Sales Div., Schenectady 5, N. Y. Details of an aqueous homogenous burner reactor and a tank type research reactor are given in two bulletins prepared by Foster Wheeler Corp., 165 Broadway, N. Y. 6, N. Y.

SIX UNIVERSITIES have signed contracts with the Atomic Energy Commission to provide concentrated courses of study designed to develop specific proficiency in chemistry, mathematics, physics, and engineering for students accepted for AEC's Oak Ridge School of Reactor Technology. Students will take the first six month's course at one of the six schools and the final six months at ORSORT. This will enable the AEC to turn out 240 nuclear scientists and engineers a year as against the present 120. The universities are: Carnegie Institute of Technology; Case Institute of Technology; Northwestern University; University of California, Los Angeles; University of Florida; and Union College, New York.

LEWIS S. STRAUSS, chairman of the U. S. Atomic Energy Commission, has proposed a plan to accelerate reactor development by industry. He would have the AEC call for a third round of proposals under the power demonstration program, with each proposal to be considered individually and acted upon as it is received. Three types would be given priority in the order listed: a large scale reactor (100,000 kw or larger capacity) fueled with natural uranium and heavy water moderated; a large scale fluid fuel reactor system (100,000 kw or larger) based on aqueous solutions and/or slurries of uranium or thorium bearing materials; and three small scale reactor projects of new design. Under the plan, industry would be given first chance to submit proposals. If appropriate plans were not received within a reasonable time, AEC would take steps to build such reactors on its own initiative.

EDISONVOLTA, S.p.A., of Milan, Italy, will purchase a 134,000 electrical kw pressurized water power reactor from Westinghouse Electric International Co. This is the first large scale power plant to be sold to a foreign buyer. The Italian utility company hopes to have the reactor in operation shortly after its prototype, Yankee Atomic Electric's Rowe, Mass., PWR goes critical.

CAROLINAS VIRGINIA NUCLEAR Power Associates, Inc. has engaged Stone & Webster Engineering Corp. as architect-engineers in a consulting and designing capacity for the nuclear power facility the group announced its intention of building last October.

THE ATOMIC INDUSTRIAL FORUM'S progress report on developments in commercial applications of atomic energy during 1956 shows that U. S. industry has begun construction or received contracts for the building of 59 new nuclear reactors, including 30 research and test reactors, and 29 power type reactors; work was in progress on 17 reactors previously contracted for; and two industrial research reactors were completed.

AEC HAS REJECTED proposals submitted by the City of Holyoke, Mass., the City of Orlando, Fla., and the University of Florida to build small power reactor demonstration plants. Holyoke's gas cooled reactor with a gas turbine, and Orlando's liquid metal fueled reactor were termed premature since basic feasibility of the two concepts has not been demonstrated. U of F's pressurized water reactor does not qualify as a power demonstration project, said AEC, because it would make only minor contributions to the art of economic power generation.

FOR THE FOREIGN MARKET, AMF Atomics (Canada) Ltd., will design and build the first privately owned and operated nuclear research reactor in Canada. The swimming pool reactor will be built at McMaster University, Hamilton, Ontario. The 10 megawatt heavy water research reactor for Tokai, Japan, also will be built by AMF. Vitro Engineering Division has the contract for engineering services on the CP-5 heavy water reactor facility in Milan, Italy. The Italian government's equivalent of the U. S. Atomic Energy Commission will operate the facility.

FERRO CHEMICAL CO. and the Signal Corps Engineering Laboratories at Fort Monmouth, N. J., have developed a photographic technique that holds promise for use in a radiation field. Key to the system is a photosensitive additive-treated vinyl plastic that is developed

by baking after exposure. Tests to date have shown the unexposed plastic to be insensitive to gamma rays from a radioactive cobalt source. The technique also requires a shorter processing time than that for conventional development.

A METHOD OF COAL GASIFICATION using two 70,000 thermal kw reactors to heat steam to 3000 F was proposed by R. W. Ritzman of the Koppers Co. at a recent meeting of the American Nuclear Society. The steam would then be used in a gasification reactor to bring the coal up to reaction temperature. Cost estimates are $1.12 per million Btu of heat as compared with $1.32 per million Btu by conventional methods. Less coal is required since process heat is supplied by steam rather than the burning of coal.

THE U. S. GOVERNMENT has offered $20 million for establishment of the Asian Regional Nuclear Center at Manila in the Philippines for use by Colombo Plan nations. The money will go for capital expenditures and initial operating costs. A team from Brookhaven National Laboratory recommended last spring that the Center be provided with an enriched uranium, light water moderated and forced cooled type reactor.

OEEC, The Organization for European Economic Cooperation, will hold a conference for management on nuclear energy in Paris, April 1-6. Papers will deal principally with various types of reactors; the first nuclear power plants, Calder Hall, Marcoule, and Shippingport; elements of cost; special materials and equipment; present stage of the art in various nations; and action under way on an international level.

UNIVERSITY OF CALIFORNIA scientists working with the Berkeley Bevatron have discovered a third way of making an energy releasing nuclear reaction take place. Described as a catalyzed nuclear reaction, it is similar to a thermonuclear reaction in that the same nuclear fusion reactions are common to both. Conditions of the surroundings are different, however.

THE NEW TRIPARTITE Declassification Guide adopted by the governments of the U. S., the United Kingdom, and Canada will permit publication of a large portion of information that has been governed by access permits, according to AEC. Specifically, information necessary to the design, construction, and operation of

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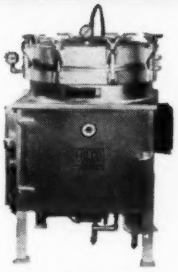

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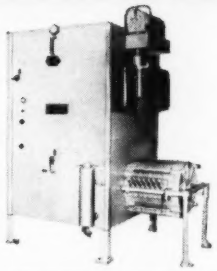
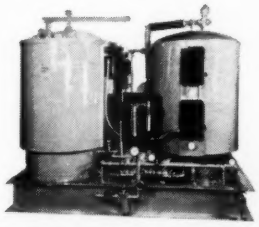


PURIFIER-RE-REFINER

For all purification in batches of from 6 to 100 gallons. Removes all solids, acids and volatile contaminants.

FILTER

Furnished in capacities from 0.1 to 750 gpm. Various cartridges available for mineral and inhibited detergent oils.



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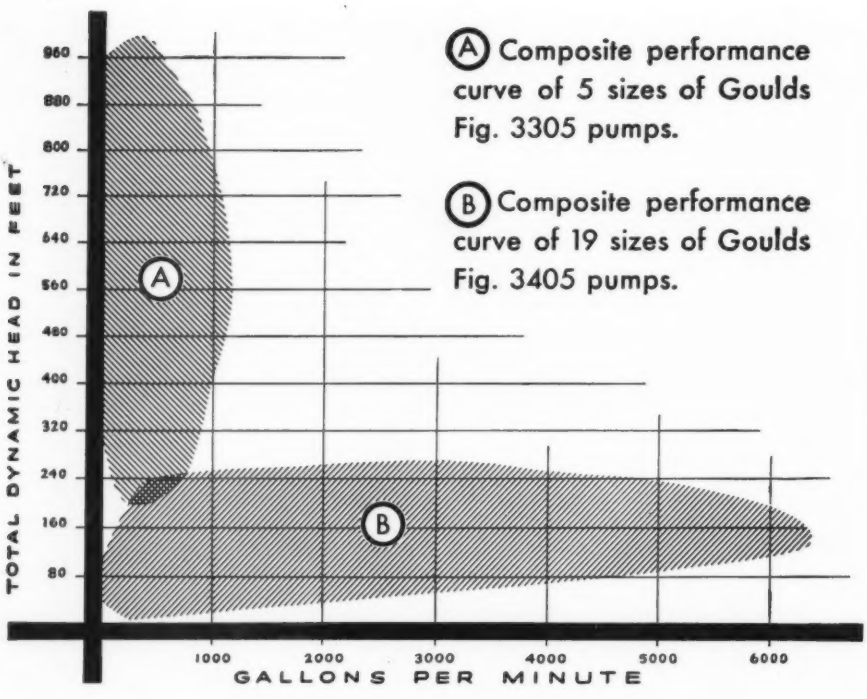
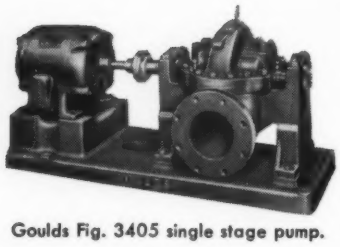


Ⓐ Composite performance curve of 5 sizes of Goulds Fig. 3305 pumps.

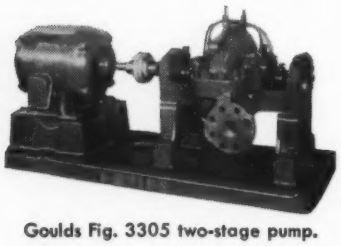
Ⓑ Composite performance curve of 19 sizes of Goulds Fig. 3405 pumps.

Do you need pumping capacity?

. . . or head? . . . or both?



Goulds Fig. 3405 single stage pump.



Goulds Fig. 3305 two-stage pump.

With these two groups of Goulds centrifugal pumps you can meet an extremely wide range of pumping requirements.

For volume pumping, 19 sizes of the Fig. 3405 single-stage, double-suction pump provide capacities up to 6,400 GPM, and heads to 280 ft.

For greater pressure requirements 5 sizes of the Fig. 3305 two-stage pump provide heads up to 1,000 ft., and capacities to 1,200 GPM.

Both of these groups of pumps have important new design and construction features that insure efficient operation and long life. Yet, because so many of their parts are interchangeable, *you can cut your parts inventory in two—or better.*

For example, you need only 3 different shafts for all 24 sizes of pumps in both groups.

We'd like to send you additional details about these pumps, including specifications and performance curves. Just write for Bulletin 721.6 about the Fig. 3405 single-stage pumps, and Bulletin 722.6 about the Fig. 3305 two-stage pumps. We'll be glad to send you copies of both.

MEMBER

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civilian power reactors will be declassified, along with data accumulated as a result of reactor experiments. Uranium production figures for the three governments, heavy water technology, and fuel fabrication methods also will be available without permits. It will be some months before all material so declassified is widely available.

IN LINE WITH the removal of trilateral restrictions, AEC announced that the U. S. has 60 million tons of measured, indicated, and inferred ore with an average U_3O_8 content of 0.25 percent. At the same time the Canadian government estimated that Canada's uranium ore reserves are 225 million tons with a uranium content of 237,000 tons.

THE BRITISH government's Central Electricity Authority has awarded contracts to two industrial reactor groups for power reactors. The Nuclear Power Plant Co. will construct a 300,000 electrical kw Calder Hall type station at Bradwell, Essex, England. A 275,000 electrical kw reactor of the same type will be constructed by Associated Electrical Industries — John Thompson Nuclear Energy Co., Ltd., at Berkeley, Gloucestershire, England. The South of Scotland Electricity Board, also part of Britain's nationalized utility industry, has a contract with the General Electric Co. and Simon-Carves Group for a 320,000 electrical kw Calder Hall station at Hunterston, Ayrshire, Scotland.

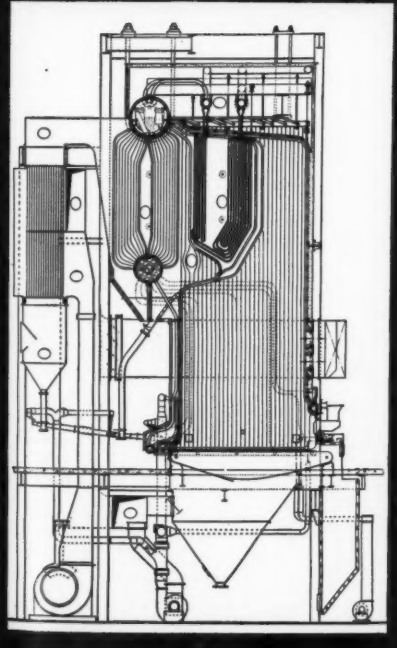
FIVE MORE AGN-201 reactors will be built by Aerojet General Nucleonics, contingent on receiving licenses from AEC. The 100-mw reactors will be offered for sale or lease. The AGN-201 installed at the U.S. Naval Postgraduate School, at Monterey, Calif., is ready to go as soon as the school has an operation license.

SYLVANIA ELECTRIC PRODUCTS, Inc. has taken options on a 150-acre site in Andover, Mass., for the atomic research and production center that Sylvania and Corning Glass Works plan to build through the jointly owned Sylvania-Corning Nuclear Corp., now being formed. The center will concentrate on development and production of nuclear fuel elements and components. The group is preparing for what it feels will be a $2 billion fuel cycle market by 1980.

AN EXPERIMENTAL BOILING WATER reactor is planned by AEC at the Idaho reactor testing station. The facility will consist of a reactor core and pressure vessel, steam

Mile High Plant Steam Generator Fired By DETROIT ROTOGRATE STOKER

Southern Colorado Power Co.



Southern Colorado Power Co.
Canon City, Colorado
W. C. Porter, Vice President in Charge of Operations
Chester Huskey, Superintendent

Stearns-Roger Manufacturing Co., Denver
Engineers—Constructors
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This new unit which triples the capacity of the plant consists of a Babcock and Wilcox two-drum single pass steam generator fired by a Detroit RotoGrate Stoker having six feeders and distributors. The plant is at 5,300 feet above sea level. Capacity of above unit is 150,000 pounds of steam per hour at 860 psi, 915° steam temperature with preheated air at 350° F.

Design is based on bituminous coal:

B.T.U. per lb as fired	10,828
Moisture	8.84%
Volatile matter	33.72%
Fixed Carbon	44.69%
Ash	12.75%
Sulphur (separately determined)	0.7%

However, operation has been completely successful with coal from various mines in the vicinity.

Detroit RotoGrate is an exceptionally efficient spreader stoker with overlapping highly restricted grates that move slowly forward discharging ash at the front. Permits high burning rates with all Bituminous coals, Lignite or refuse fuels. *Write for Bulletin.*

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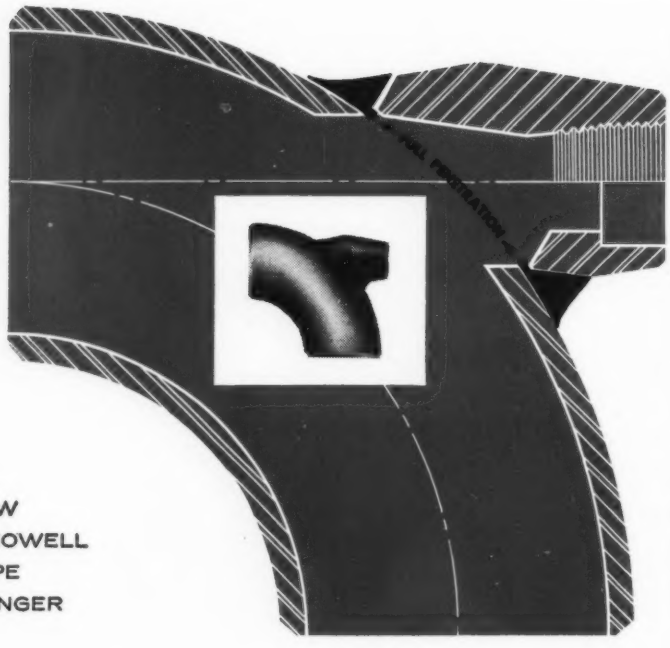

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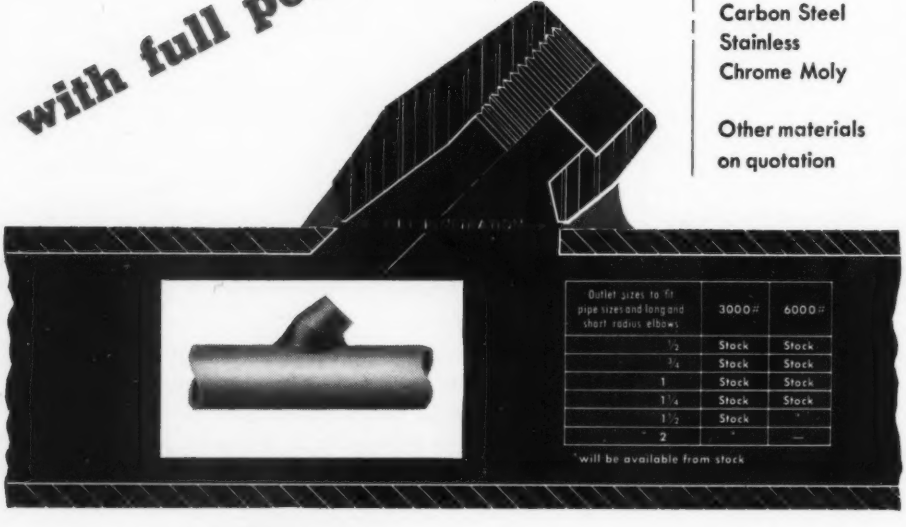

Outlet sizes to fit pipe sizes and long and short radius elbows	3000#	6000#
½	Stock	Stock
¾	Stock	Stock
1	Stock	Stock
1¼	Stock	Stock
1½	Stock	*
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condensers, heat exchangers, pumps, and the necessary valves, controls, and auxiliary equipment. Argonne National Laboratory will design and operate the reactor. An architect-engineer will be selected at a later date to design the reactor building.

THE THREE "WISE MEN" appointed by the six governments negotiating a treaty to establish the Euratom atomic energy pool visited the U.S. in January at the State Department's invitation. Purpose of the visit was to study nuclear development, prospects, and problems in this country. The group, which will be responsible for developing an atomic power program for the Euratom community, is made up of Louis Armand, of France; Franz Etzel, of Germany; and Francesco Giordani, of Italy.

MAXIMUM permisssible cumulative radiation dose for both atomic energy workers and the general population are being revised downward by the National Committee on Radiation Protection on recommendation of Lauriston Taylor, chairman of the group. Taylor's plan would limit the radiation dosage for the general population at age 30 to a cumulative dose of 10 roentgens per person, as against the present limit of 45 roentgens. Under the reduced limits, he feels, reasonable testing of atomic weapons could continue indefinitely without harm to the population and the atomic industry could expand without limit within the foreseeable future.

NORTH AMERICAN Aviation's Atomics International Division has completed the installation of the zirconium clad graphite moderator in the Sodium Reactor Experiment that NAA is building for AEC at Santa Susana, Calif. Operation is scheduled for early this year. Southern California Edison already has installed a turbine generator expected to produce 7500 kw of electricity from SRE heat.

THE NEW two-story building at the Knolls Atomic Power Laboratory houses two nuclear reactors for experimentation and an IBM digital computer that can solve in seconds problems that would take mathematicians months to work out. Reactors will produce no power or heat but will be used to obtain physics and nuclear design information connected with development of nuclear power plants. The computer will be used for solution of power plant design problems in nuclear physics, heat transfer, stress analysis, reactor control, and systems transient response. ▲▲

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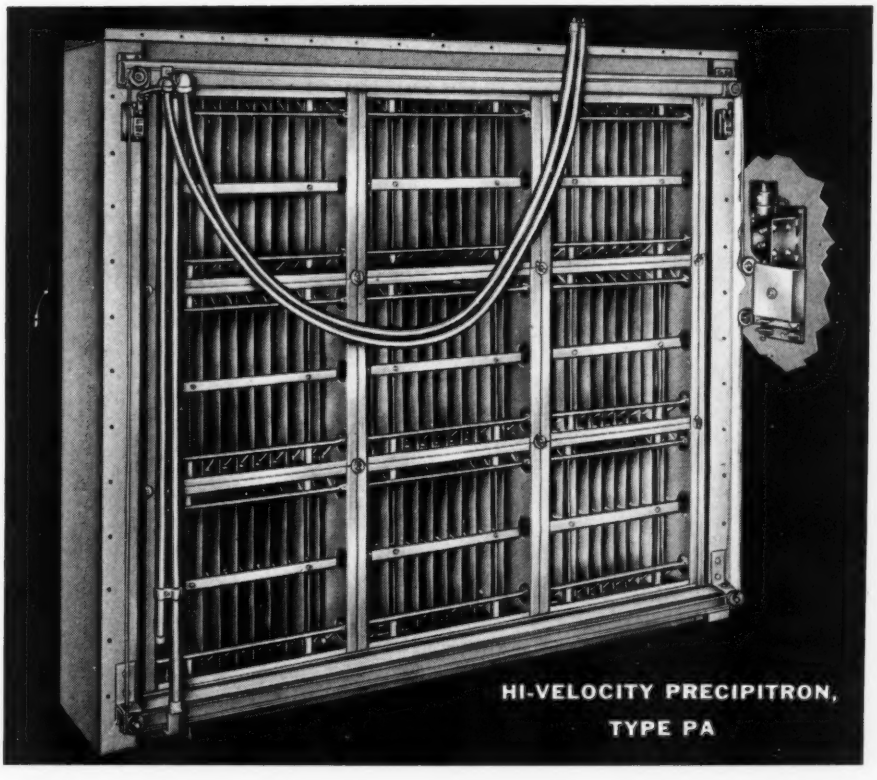

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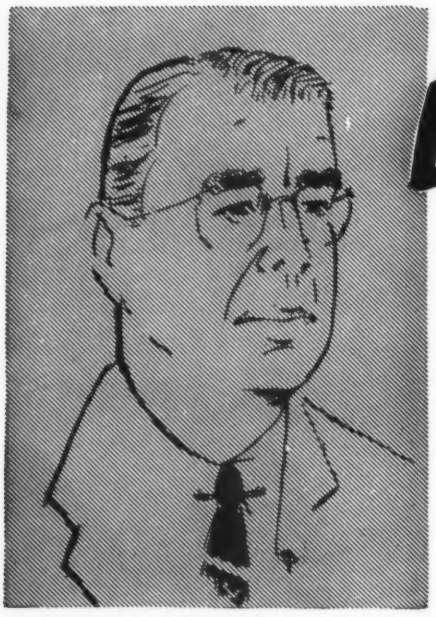

Economic News Notes

E. A. MacDonald
INDUSTRIAL ECONOMIST

FORECAST CAROUSEL — Optimistic: Mr. E. B. George of Dun & Bradstreet looks for general business activity to rise to record heights, with the value of the nation's product around $440 billion this year, $27-$28 billion more than last year. Cautious: Prof. M. P. McNair of Harvard believes that while there will be no downturn in the economy this year, it will "flatten out its rate of growth considerably." This "will represent a . . . needed breathing spell, to insure a vigorous forward advance a little later." Pessimistic: Prof. V. L. Bassie of the University of Illinois warns, "The economy is not likely to hold another year at the current high level . . . The decline will probably be substantial and not just another minor recession . . . "

HEAVY DEMAND — The United Auto Workers Union has announced intentions of biding for "tens of thousands of engineers now outside the union." This takes another turn in the growing tightness of competition for engineers between AFL-CIO and independent Engineers and Scientists of America. For a recent study of unionization of engineers, read the National Industrial Conference Board's recent report, "Unionization Among American Engineers."

BENEFICIAL RESULTS — Despite tight money and rejection of accelerated amortization applications, prospects are still good for high levels of construction in the basic areas of steel, chemicals, and heavy industries. Estimates made at the recent meeting of the National Constructors Assoc. by individual construction firms of their own activity for 1957 ranged from gains of 20 to 100 percent over work put in place last year. The opinion was voiced by a number of construction firms that the tight money situation was having the favorable effect of stabilizing activity by lengthening the planned capital expansion programs.

RECOMMENDED READING — Contending that the piecemeal approach now used by cities to attack traffic congestion fails completely, Mr. W. Owen argues that the answer lies in a total program including expressways, parking facilities, terminals, and transit facilities for the whole metropolitan area. In his recently published book, "The Metropolitan Transportation Problem," Mr. Owen defines the first need as construction of a controlled-access highway system, pointing out that there are only 375 miles of modern expressways in the 25 largest cities.

WOOD RESEARCH — New wood and wood products "will be more applicable to today's and tomorrow's construction conditions, and in some instances, will foster entirely new construction practices." Mr. R. H. Gloss of Timber Engineering Co., an engineering and research affiliate of National Lumber Manufacturers Assoc., adds that research aims to tailor lumber and lumber products more closely to construction needs.

BRICK RESEARCH — Buoyant lightweight bricks as strong as the common garden variety but affording a much greater scope of uses are the result of research carried out by the brick industry's research center at Geneva, Ill. Barron's reports (12/24/56) that this institution's engineers have devised a machine that assembles and packs up to 100,000 bricks a day. Packaged bricks, of course, offer tremendous economies.

QUOTE-OF-THE-MONTH — "The inexorable increase in the rate of increase (of the world's population) is unique . . . Unless it is checked, mankind will face a terrible dilemma." Population Reference Bureau, 12/12/56.

STEEL MUSCLES — The American Iron & Steel Institute has announced that the nation's steelmaking capacity was boosted to 133,459,150 net tons during 1956. This was an increase of over 5 million tons, the 10th consecutive gain, and enables this country to produce more than 40 percent of the world's output. A feature of the current growth of the steel industry is the "largest open hearth furnace in the history of steelmaking" which was recently fired by Weirton Steel Co. With a capacity of 600 tons, it is almost double the size of most open hearth furnaces.

UTILITY ECONOMICS — Data released by the American Gas & Electric Service Corp. show that efficiencies in the design of a power plant to be built for Indiana and Michigan Electric Co. on the Wabash below Terre Haute save nearly 50 percent in space requirements. The generating unit is reported to be 73 percent larger

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A. SPECIFY BORDEN and receive a completely custom fabricated floor grating in cluding cut-outs, toe plates, fasteners and stair nosings. Be sure with BORDEN'S FREE PLANNING AND CHECKING SERVICE.

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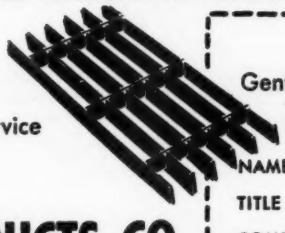

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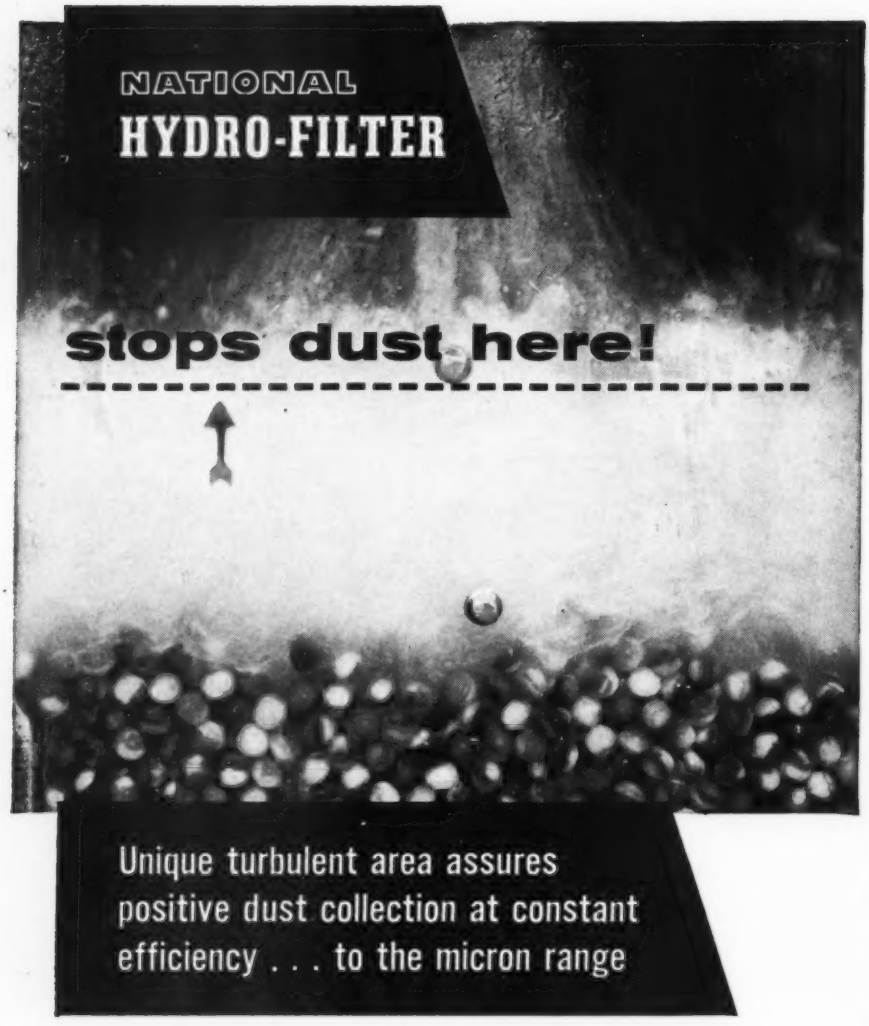


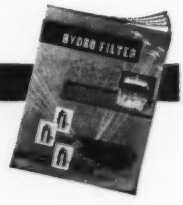
Unique turbulent area assures positive dust collection at constant efficiency . . . to the micron range

Here is the "heart" of the Hydro-Filter principle of dust separation. This violently turbulent area of water, bubbles and mist is produced by the countercurrent action of air against water. Constant long contact between the air being cleaned and the water which is doing the cleaning produces a scrubbing action which is positive, thorough and unaffected by variation in volume and velocity of flow. Dust is entrained by any, or all, of three means: (1) Entrapment within falling water droplets; (2) Impingement on bubble surfaces; (3) Impingement on wetted surface of glass spheres.

As the photo indicates, the entire collection area is continually flushed. There are no dead areas to corrode or erode. No moving parts to "load up" and reduce efficiency. Maintenance is a matter of *minutes a month*. Collection of dust to micron size is continuous and sludge removal automatic with the National Hydro-Filter.

Write for Bulletin 55 . . .

See why and how separating efficiencies of up to 98.9% on foundry shakeout dust are possible practical—and continuous with Hydro-Filter!



NATIONAL

Dust Collector Corp.

606 Machinery Hall Bldg., Chicago 6, Illinois

Subsidiary of National Engineering Company, Manufacturer of Simpson Mix-Mullers.

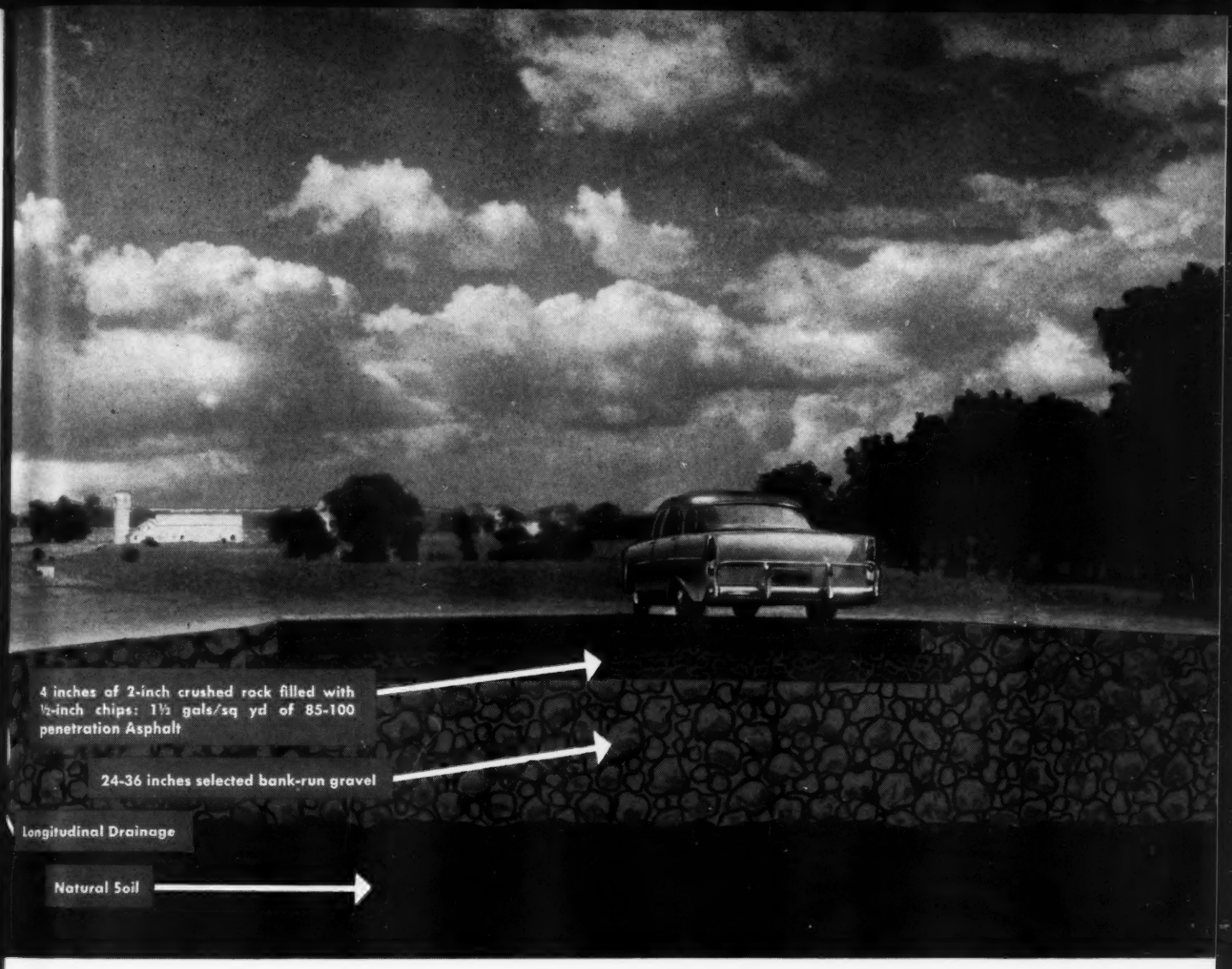
than any power generator that is now in operation in this country.

"IMPOSSIBLE COMPETITION" — Exists when a private firm with a government contract can offer "any amount" necessary to lure engineers and scientists away from government employment. So claims Representative Davis (D-Ga.) who says that his House Civil Service subcommittee "feels strongly that steps must be taken to reduce undue competition for engineers and scientists."

PROGRESSIVE PROGRAM — A 6 percent pay boost for engineers has been approved by the Michigan Civil Service Commission in order to be competitive with private industry. Engineers with degrees but sans experience start now at $5115. The Michigan Highway Dept. is trying to combat the engineer shortage by all possible desirable means: giving design work to private firms, making greater use of electronic computers, assigning routine work to non-professional engineers, letting jobs in larger amounts to cut down paper work, and providing extensive summer programs for student engineers.

GET IN LINE — 375 companies had requested, it was reported by "Business Week," interviews with the 330 students up for degrees in engineering and science next June at Carnegie Tech. This was the tally at the end of last November. Five years ago, only 58 companies had signed up by the end of November.

THROUGH THE TRANSIT — Significant First: The first bill thrown into the hopper for the current session of Congress was Federal aid for school building. . . . Tuition-free Cooper Union in NYC has announced plans for a $3.5 million building for its engineering school. . . . Skyscrapers scheduled for erection in NYC include a $70 million, 47-story office building by Rockefeller Center Inc. and Time Inc. and a $13 million, 30-story office tower in the Grand Central — UN Hdqtrs. area. . . . And talking of skyscrapers, what happened to architect F. L. Wright's startler, the "Illinois Sky-City," the mile-high, 528-story building with a "tap-root" foundation and "central pylon carrying cantilevered floor slabs."..... 1956 has gone into the records as the worst "fire year" in the nation's history. The National Fire Protection Assoc. reports property destroyed by fire last year amounted to a record $1,250,000,000. . . . Western Pine lumber stocks rose 17 percent last year, to a postwar high of 2.1 billion board feet.


4 inches of 2-inch crushed rock filled with ½-inch chips: 1½ gals/sq yd of 85-100 penetration Asphalt
24-36 inches selected bank-run gravel
Longitudinal Drainage
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only $36.07 to maintain (per mile, per year)

macadam, topped with a double Asphalt surface treatment. Most sub-base material came from the right-of-way or adjacent borrow.

Bids for the Asphalt structure ran $85,000 per mile under next lowest bids for pavement of comparable specifications. Such a saving pays for many years of maintenance . . . not only of the pavement but of the entire right-of-way.

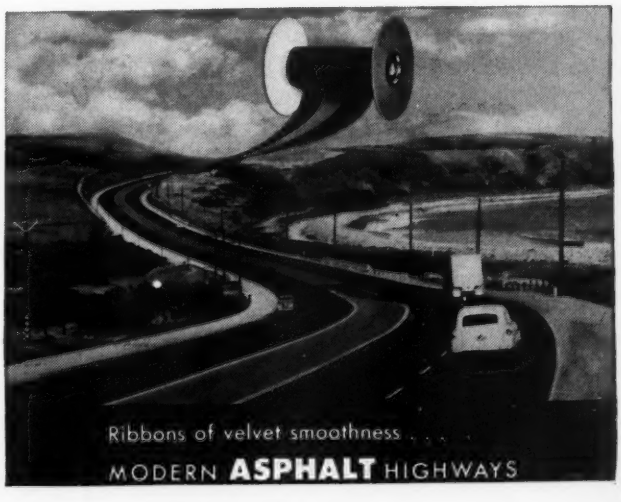
What about performance?

John O. Morton, New Hampshire Commissioner of Public Works and Highways, has this to say, "The pavement has shown performance during its first five years of use that leaves nothing to be desired."

For low costs, long life, high performance . . . for smooth, safe riding . . . design for Asphalt construction.

Safety is not a function of cost

Despite its low construction and maintenance costs, New Hampshire's Asphalt Turnpike has achieved one of the best safety records on major highways in the nation.



THE ASPHALT INSTITUTE
Asphalt Institute Building, College Park, Maryland

The Legal Aspect

MELVIN NORD, P.E.
Consultant in Legal and Technical Problems
Patent Attorney

Atomic Energy Law (Introduction)

Atomic energy, one of the newest fields of technology, and potentially one of the most important, is a field in which consulting engineers will eventually play a very important role.

Not only is the technology in this field new and novel, but so are the legal aspects. A number of innovations in law and legal concepts have arisen in the atomic energy area, and a great many more will be needed as the field "mushrooms out." Thus, it seems useful to consider here what the law of this subject is at present, what the uncertainties and difficulties are, and what changes are foreseeable.

Atomic Energy Act of 1954

The original Atomic Energy Act was passed in 1946. This gave the Federal Government an absolute monopoly over all phases of atomic energy — or perhaps it would be more accurate to say that it retained such monopoly for the government. Very little information was available to the public, and all activities in the atomic energy field were to be conducted by the Federal Government.

The 1954 Act changed the situation (or recognized the changed situation) in a number of ways. The most important of these were some loosening of information control, limited provision for international activities, and allowing the Atomic Energy Commission (AEC) to license private operations in the peaceful uses of atomic energy.

The 1954 Act is the basis of the present law, together with the rules and regulations adopted by the AEC under it, and the international arrangements entered into by the United States. While this law suffers from many defects and difficulties, it must be regarded as simply an interim stage in the process which started originally as 100 percent government monopoly, and which is tending slowly toward a normal economic situation. With this perspective in mind, one can better understand the reason for some (but not all) of the peculiarities of the Act.

Policy of the Act

Section 1 of the Act reads as follows: "Atomic energy is capable of application for peaceful as well as military purposes. It is therefore declared to be the policy of the United States that —

"a. the development, use, and control of atomic energy shall be directed so as to make the maximum contribution to the general welfare, subject at all times to the paramount objective of making the maximum contribution to the common defense and security; and

"b. the development, use, and control of atomic energy shall be directed so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise."

Thus, in the opening section of the Act, the continuing paramountcy of the military phases of atomic energy is emphasized. Subject to this, peaceful applications are now to be developed (1) to promote world peace, through international cooperation (and if possible through international controls), and (2) to promote prosperity, through spreading the base of operations into private competitive industry.

The term "atomic energy" itself, which is a misnomer, is defined in the Act Sec. 11c as "all forms of energy released in the course of nuclear fission or nuclear transformation." This definition should be kept in mind at all times in connection with the Act, since it includes not only what is generally included in the term, but also nuclear fusion, the recently discovered "catalytic nuclear process," and any other nuclear process that releases energy.

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Continuing research and constant new developments in both engineering and manufacturing divisions have made possible the introduction of many new ballasts with exclusive patented features. Thus, ADVANCE provides lighting equipment manufacturers, designers, architects, engineers, contractors and other fluorescent lamp ballast users the world's most extensive line of fluorescent lamp ballasts. When you use ADVANCE, there is a ballast for every specific purpose, never a need to compromise.

ADVANCE ballasts are listed by Underwriters' Laboratories, Inc., meet the Canadian Standards Association requirements and many meet or exceed Certified Ballast Manufacturers' specifications. Specify ADVANCE to be sure to get the ballasts with the "plus factors" that have built the world's largest company devoted exclusively to the manufacture of fluorescent lamp ballasts.

The Advance Transformer Company will replace, at no charge, any ADVANCE fluorescent lamp ballast which becomes inoperative within two years from date of manufacture, provided the conditions of ballast operation have conformed to the company's recommendations and the inoperative ballast is returned to an authorized ADVANCE Service-Stocking Distributor.

For anyone who manufactures, specifies, installs or uses fluorescent lighting, ADVANCE TRANSFORMER COMPANY has prepared helpful literature which they will gladly send without cost or obligation.

Fluorescent Lamp Ballast Buyer's Guide

This eight-page brochure gives data on the world's most complete line of Fluorescent Lamp Ballasts. It includes specifications, wattage, watt loss, circuit voltage, dimensions, weight, etc. This brochure is an invaluable aid for specifiers and users of fluorescent lamp ballasts.

Fluorescent Lamp Ballast Cross Reference Guide

This helpful guide lists many popular ballasts by catalog number and the ADVANCE ballast that should be used whenever ballast replacement becomes necessary. It is an invaluable reference chart that saves time and money for all users of fluorescent lamp ballasts.

Service-Stocking Distributor Plan and List of Distributors

This is a six-page color brochure that lists, by city and state, more than 550 distributors who carry a stock of ADVANCE Fluorescent Lamp Ballasts, to provide immediate replacement service for *ballasts of any make* that become inoperative.

You may receive a copy of one or all of these brochures by writing ADVANCE TRANSFORMER COMPANY, Marketing Division, 2950 North Western Avenue, Chicago 18, Illinois.

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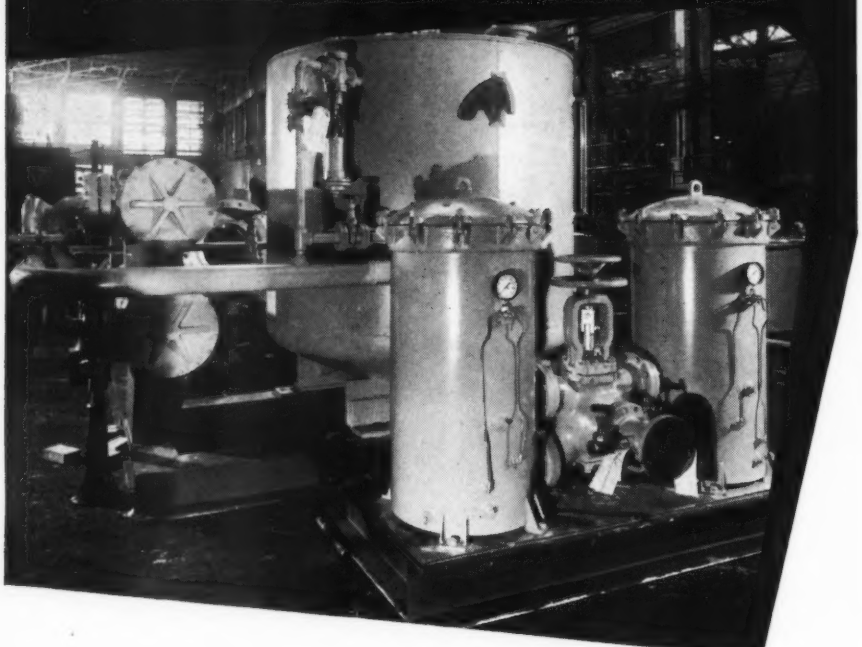
No Foreign Matter Larger Than 2 Microns in this compressor lube oil system



...It's NUGENT Filtered

The photo above shows an Allis-Chalmers lube system package consisting of pump, cooler, filter, tank, and console for a centrifugal compressor being readied for shipment to a southwestern petrochemical plant. In the foreground is the Nugent 1555 BF-4L7 Duplex Lube Oil Filter which protects the lube oil used in the compressor.

This large capacity duplex full flow filter consists of two parallel filters with a flanged switching valve supported between them. Each filter is equipped with a three-way cock and differential pressure gauge and has a capacity of 225 GPM of 150 SSU viscosity lubricating oil at about 5 psi pressure drop. They may be operated independently or in parallel.

Filter recharges are laminated, crenulated fiber disc type, providing 20 times more filtering area than other filters of comparable size. The recharges have a useful life 4 to 10 times that of other types and are expendable.

Nugent Full Flow Filters will remove foreign solids as small as 2 microns from lube or fuel oil before they can reach and damage vital precision parts. Give your engines and compressors the advantage of Nugent Full Flow Filtering — they'll reward you with longer trouble-free service.

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Laminated crenulated fiber disc cartridge used in the Nugent Duplex Full Flow Lube Oil Filter.

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Congressional Findings

Sec. 2 of the Act provides: "The Congress of the United States hereby makes the following findings concerning the development, use, and control of atomic energy:

> "a. The development, utilization, and control of atomic energy for military and for all other purposes are vital to the common defense and security."

This subsection states the principal justification for the granting of very broad powers by Congress to the AEC, and is based on the military applicability of fissionable materials and information as to their production or use. In other words, the provisions of this Act are based on the assumption that the peaceful uses of atomic energy must be controlled rigidly, in order to avoid diversion of fissionable materials to military purposes or the disclosure of information of military importance to unfriendly countries.

As to diversion of materials for military purposes, there can be no doubt that proper controls will be needed to prevent this during the foreseeable future. To be sure, other military explosive materials are under no special peacetime controls, but nuclear explosives are in a class by themselves.

Diversion of Information

As to diversion of information, undoubtedly some of it has direct military significance and must be controlled, e.g. information as to the bomb itself. It is claimed by the AEC that other information is also of indirect military significance, in that it would aid other countries to produce fissionable materials which could be diverted to military purposes. The question of information control is one of the most controversial issues in atomic energy, and will be treated more fully in a subsequent column in this series.

> "b. In permitting the property of the United States to be used by others, such use must be regulated in the national inter-

Bayley Engineered AIR HANDLING EQUIPMENT

Whether used individually or in combination, the BAYLEY units shown below are designed to efficiently and economically serve your air-handling requirements. Bayley specialists have designed and engineered this equipment to assure maximum service and efficiency for every purpose for which it may be installed.

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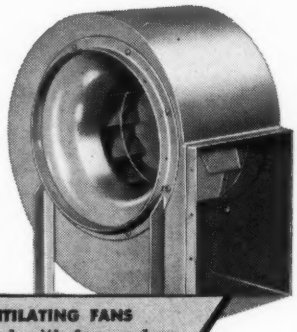
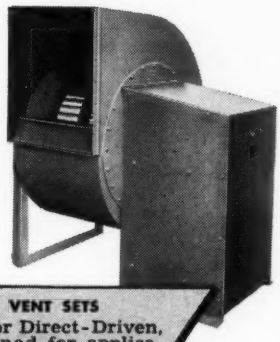


VENTILATING FANS
Equipped with forward or backward curved wheels — for Ventilating Conditioning, Mechanical Draft.



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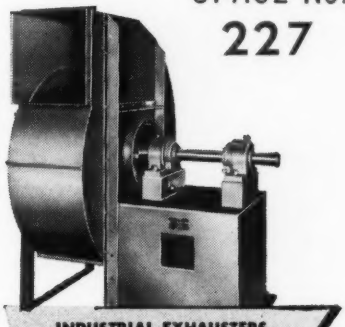
Belt or Direct-Driven, designed for applications requiring moderate air volume.



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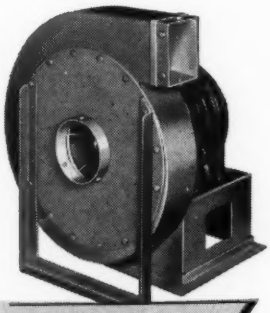

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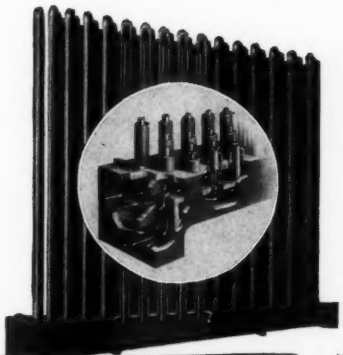
For draft and conveying with moderate air volumes at relatively high pressures.



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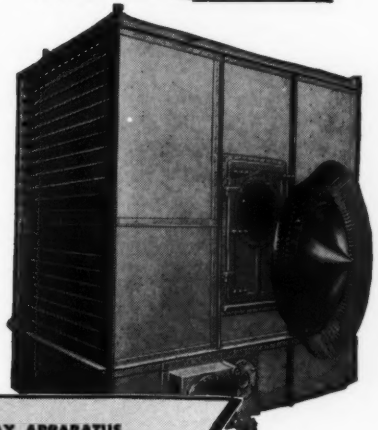
Blast Coils — Aerofin and Chinook; Heating and Cooling; Steam, Water, Direct Expansion.



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Sellersville, Pa.

Home of the SUPERGAUGE

est and in order to provide for the common defense and security and to protect the health and safety of the public."

This innocuous statement has greater significance when one learns that the United States Government has an absolute monopoly over the ownership of all nuclear fuels. Since the government owns this property, it obviously can place very strict restrictions on its use when it "lends" it to private persons or to industry for use in power plants.

"c. The processing and utilization of source, by-product, and special nuclear material affect interstate and foreign commerce and must be regulated in the national interest."

The terms "source material," "by-product material," and "special nuclear material" will be defined in detail subsequently, but for the present it suffices to say that they mean, respectively, ores or processed (but not isotope-enriched) ores, radioactive isotopes, and nuclear fuels. Thus, subsection (c) provides other constitutional grounds (i.e. interstate commerce) for regulating activities involving all these materials.

"d. The processing and utilization of source, by-product, and special nuclear material must be regulated in the national interest and in order to provide for the common defense and security and to protect the health and safety of the public."

This supposedly adds other grounds for control over these materials. It is, however, difficult to see how radioactive isotopes used in medical research or treatment, or in engineering practice, affect "the common defense and security."

State Control

While they undoubtedly require control in order to protect public health and safety, such control would normally be expected to be provided by the state governments under their police power. There is, in fact, considerable

Trambeam Handles it Overhead

Heavy materials move from receiving and through production rapidly via Trambeam. Loads up to 15 tons travel above traffic, save valuable floor space. Track, carriers and motor drives are engineered in a range of sizes to accommodate present needs — have the desired flexibility to meet future expansion. No fumes, jammed aisles or dangerous floor traffic when Trambeam does the job!

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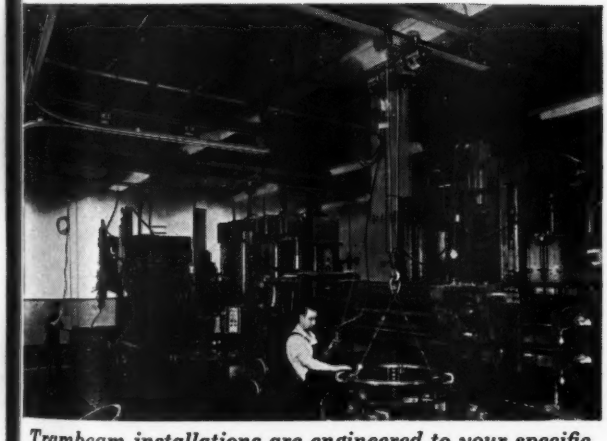

Trambeam installations are engineered to your specific requirements . . . monorail (as shown above) for point to point transport or crane for complete area coverage. Trambeam is the most efficient method of handling materials and products and the most economical!

Trambeam flexibility is a great advantage in handling materials outside the plant as well as inside. A sign company, for example, moves their products via Trambeam from raw steel through fabrication onto shipping dock as shown above.

in and out of the plant

WHITING

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This 24-page Booklet gives complete information on custom engineered Trambeam Overhead Handling Systems. Photos of many installations. Write today to

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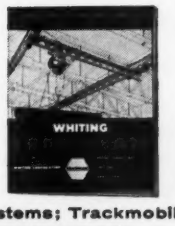

Manufacturers of Cranes; Trambeam Handling Systems; Trackmobile, Foundry, Railroad and Chemical Processing Equipment

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Both types are precision made of the finest materials . . . And, feature after feature has been designed to make the Verti-Line Turbine Pump today's best buy in vertical pumps.

More than 100,000 satisfied vertical pump users agree there's no pump like Verti-Line for low first cost, economical operation, and negligible maintenance. Whatever your vertical pump needs may be, it will pay you to investigate Verti-Line before you buy.

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doubt as to whether or not subsections (c) and (d) supersede the power of the states to provide health and safety regulation —at least in the case of radioactive isotopes and in the mining and interstate transportation of radioactive ores. The states are beginning to enter this field of regulation, although the constitutional question has not been resolved. As a result, there is a fair possibility of conflicting requirements between state and federal governments.

"e. Source and special nuclear material, production facilities, and utilization facilities are affected with the public interest, and regulation by the United States of the production and utilization of atomic energy and of the facilities used in connection therewith is necessary in the national interest to assure common defense and security and to protect the health and safety of the public.

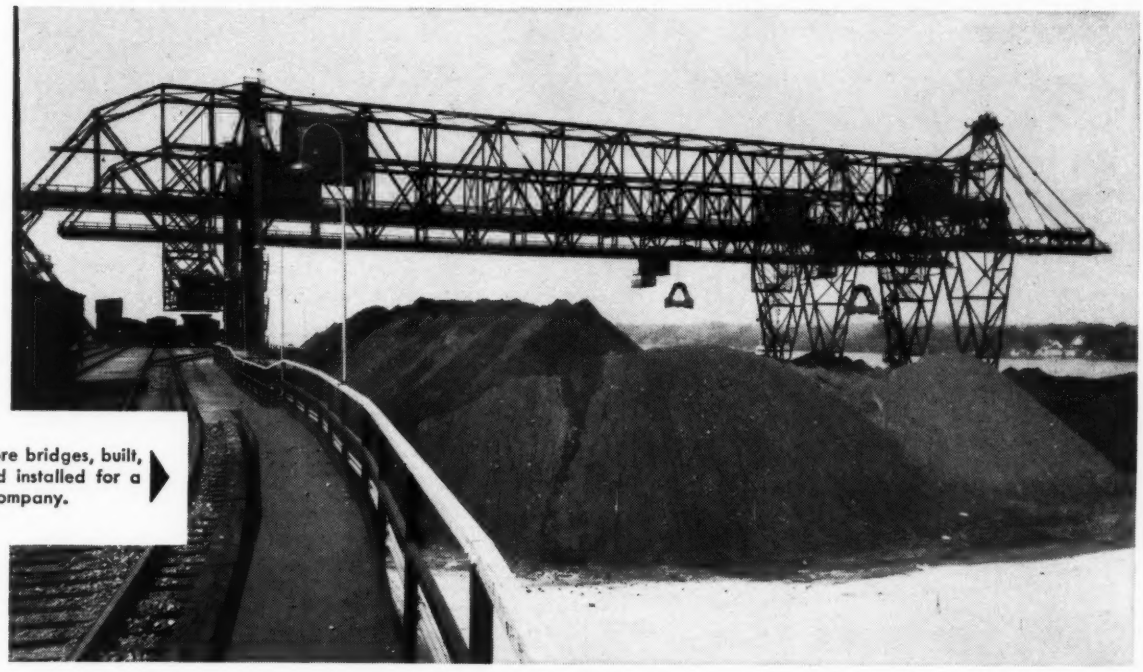
"f. The necessity for protection against possible interstate damage occurring from the operation of facilities for the production or utilization of source or special nuclear material places the operation of those facilities in interstate commerce for the purpose of this Act."

Subsections (e) and (f) are similar to (d) and (c), respectively, but apply to production or utilization facilities instead of to source, by-products, or special nuclear materials.

Power Plants

"g. Funds of the United States may be provided for the development and use of atomic energy under conditions which will provide for the common defense and security and promote the general welfare."

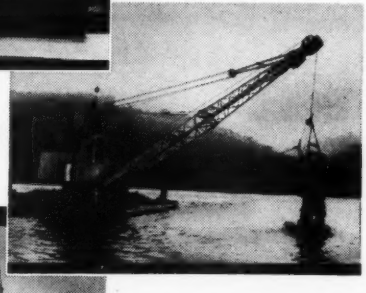
This subsection authorizes the AEC to use funds granted it by Congress for research and development, and also to build commercial power plants in competition with private industry. Thus far, the AEC has restricted it-



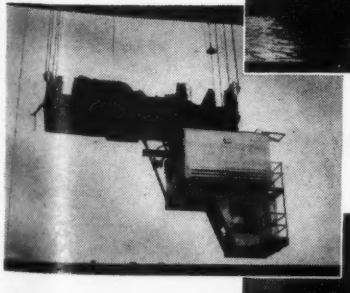
Two 12-ton ore bridges, built, designed and installed for a large steel company.

DRAVO HEAVY MATERIALS-HANDLING EQUIPMENT ...CUSTOM BUILT FOR YOU!

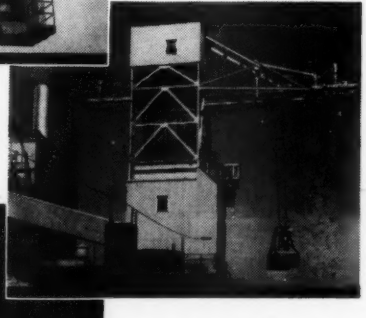
Travelling unloading towers built to handle imported iron ore at an Atlantic port.



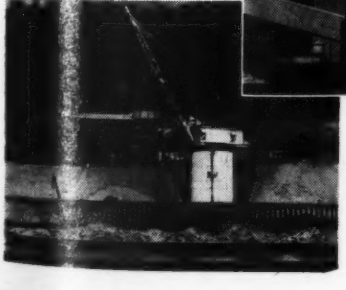
Whirler crane mounted on pontoon hull is used for dredging and general contract work.



Light-weight man trolley installation increased bridge handling capacity 60%.



Coal unloader designed and built for a large mid-western electric power company.



Stationary whirler crane designed and built to transfer coal from barges to hopper cars.

Over-all economical and safe performance is best obtained by using materials-handling equipment designed to suit your operating conditions. If you're planning a new materials-handling installation, we suggest an early "Round Table" session with Dravo engineers.

From actual experience over the past 60 years in building and installing the equipment shown here, valuable data is available in working out the features you want in your installation. This information, along with your own operating experience, can be used to create a design incorporating all the best features for easy maintenance, a high safety factor and simple, economical and satisfactory operation.

You can profit by taking advantage of this specialized "Round Table" service.

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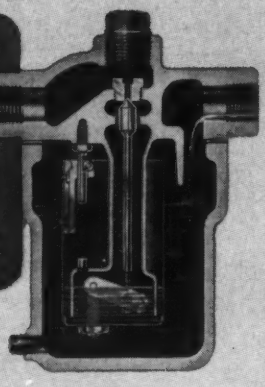
Reliability

DESIGNS THAT REPRESENT 50 YEARS TRAP BUILDING EXPERIENCE



"airxpel"

STEAM TRAPS *Remove Both Air and Condensate*

This equipment offers design advantages that represent long experience in building steam saving devices for industry.

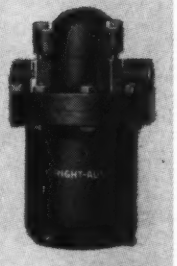
Orifices of Wright-Austin traps can be interchanged without disassembling the trap. Connections are the straight-through type. Both of these features contribute to speed and ease of installation.

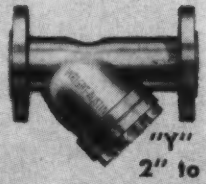
Wright-Austin traps are available for lines ½" to 3", for pressures up to 600 P.S.I.G. and with capacities up to 65,025 pounds of water per hour.

For complete information on traps and other accessories that you can stock to advantage and depend on for efficiency that means low cost, write, today, for:

"CUB" TYPE ½" to 1½" to 250 PSIG

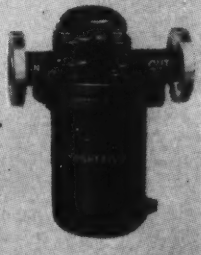
"MASTER" TYPE ½" to 2" to 300 PSIG



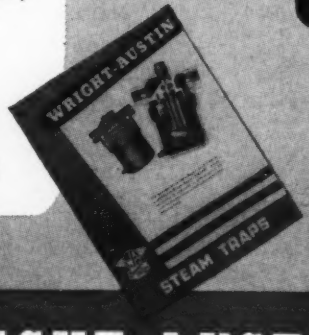


"Y" STRAINERS 2" to 8" (flanged) ½" to 3" (threaded)

FORGED STEEL ½" to 1¼" to 600 PSIG



Trap Catalog #600
Separator Catalog #500
Boiler Trim Catalog #700



WA Standard with STEAM USERS SINCE '94

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self to research and development in the reactor field (except in the building of naval vessels), but is "threatening" to move into commercial power production if private industry fails to accelerate its program. This issue of public versus private power production in the atomic energy field will be treated more fully in a subsequent article in this series.

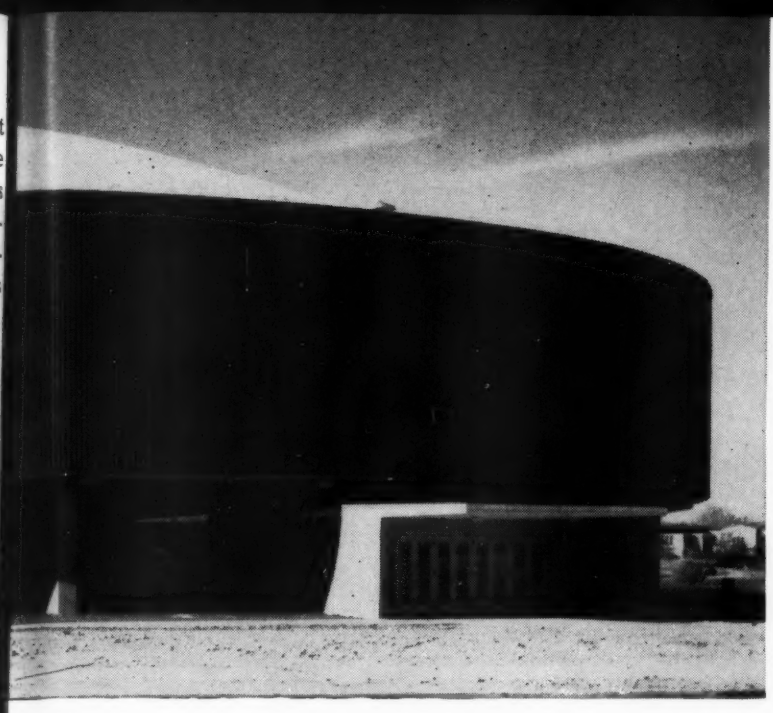
Title to Fuels

"h. It is essential to the common defense and security that title to all special nuclear material be in the United States while such special nuclear material is within the United States."

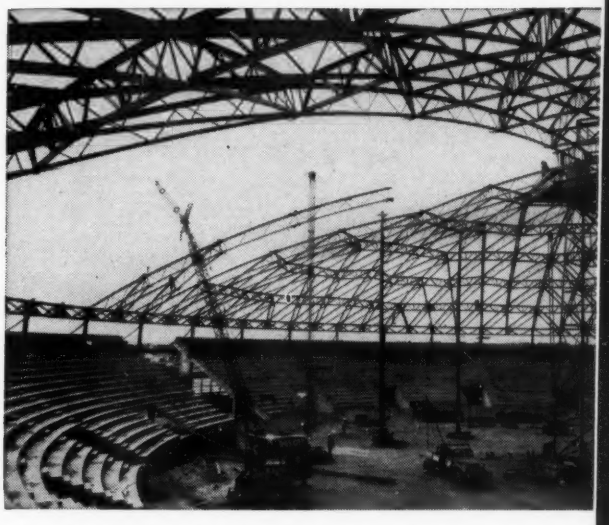
This is one of the more controversial portions of the Act. According to most people who have studied the situation carefully, it is not essential for the government to have legal title to all nuclear fuels. Having such title simplifies control to some extent, but not much. It does prevent the establishment of competitive market prices for nuclear fuels, for the source materials from which the fuels are derived, and for the by-product radioactive sources. However, it also makes uncertain the cost of producing electric power from atomic energy. It is certainly the point of view of industry that the diversion of nuclear fuels to military purposes can be prevented effectively without the necessity for the government retaining title to these nuclear materials. ▲▲

Expert Witness Reprint

Robin Beach's five articles on "The Engineer as an Expert Witness" are available in a 16-page reprint for $1.00. Please write to: Reader Service Dept., CONSULTING ENGINEER 227 Wayne St., St. Joseph, Mich.



UNIVERSITY OF WICHITA FIELD HOUSE. Architects: Lorentz, Schmidt, McVay, and Peddie, Wichita, Kansas. **Steel Fabricator:** Watkins Inc., Wichita. **General Contractor:** Dondlinger and Sons Construction Company, Wichita. **Designer and Engineer of Lamella Roof Structure:** Roof Structure Inc., Webster Grove, Missouri.



THE ROOF STRUCTURE is supported by 36 10WF39 columns. A trussed ring girder, 39 inches deep, rests on top of the columns and runs the entire perimeter of the building. Into this ring girder are framed 12 radial trusses which span to the compression ring at the apex of the roof. Also springing from the ring girder at intermediate points are curved roof trusses which intersect the radial trusses, resulting in the characteristic diamond-shaped lamella pattern.

lamella dome of Structural Steel

432 tons of steel erected in only 14 days

The unique lamella dome of Structural Steel which crowns the University of Wichita's new field house is the *first* such dome ever to be constructed. It was designed, developed and put to use for two practical reasons—economy and speed of erection.

Spanning 65,000 square feet, the 432 tons of Structural Steel were erected by two crews in the spectacular time of just 14 days! Starting on opposite sides of the building, the two crews worked around in one direction until closure was effected. The only falsework required was a central tower supporting the compression ring, or "lantern," at the apex of the dome. All connections were bolted during erection, then field-welded.

Built at a total cost of $1,405,700, the ultra-efficient structure includes such features as a complete heating and ventilating system (with radiant heating in the locker rooms), and color-corrected vapor lighting for the arena. And, with peripheral seating, not one of the 10,235 seats is more than 86 feet from the playing surface.

Where economy, speed of erection, and dramatic design are the keywords of construction, that's where you'll find versatile Structural Steel. Moneywise, Structural Steel is the most economical of load-carrying materials. And, it's the strongest. It will withstand more abuse than other structural materials, effectively resisting tension, torsion, compression and shear. Once enclosed in buildings, it lasts indefinitely, requiring no maintenance.

USS STRUCTURAL STEEL

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UNITED STATES STEEL

Structural Steel may be riveted, bolted or welded, and may be erected in any weather. Since steel members are fabricated indoors, weather can have no effect on the quality of workmanship. Want more information? Return the attached coupon.

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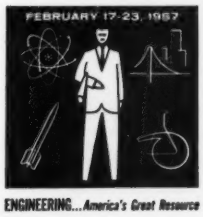
NATIONAL ENGINEERS' WEEK



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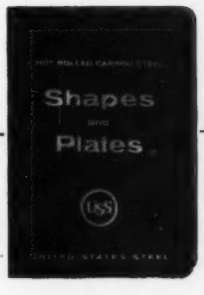

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FIRST
STEEL MESH DECK
Still Making History!

The first installation of an open steel grid flooring on any bridge in the world was made in 1932, on the University Bridge, Seattle, Washington, by the Irving Subway Grating Co. The previous solid pavement on the bridge had been plagued by frequent repairs and accidents.

After 24 years this decking is still in service on the Seattle Bridge. It has had no major repairs and has never even been painted. Not a single accident has occured due to the bridge flooring.

Since then, 80% open Irving Decking has been used advantageously on hundreds of other bridges.

This remarkable record of service speaks for itself.

★

Write for complete information on Irving Bridge Decking.

ECONOMICAL
SAFE
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"A Fitting Grating for Every Purpose"

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Originators of the Grating Industry

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Notes From Abroad

Six Year Engineering Course

An educational experiment designed to help ease the threatened shortage of engineers in Canada may be inaugurated at Waterloo College, Ontario, in 1957. The school proposes to admit students who have completed grade 12 in either vocational or high schools. For the first two years students will study grade 13 subjects required for university admission, some first year university subjects, and will receive at least 12 hours a week instruction and lab work in technical subjects.

At the end of two years, students who qualify in their academic subjects may take a four-year engineer's degree course. Students who fail to qualify in academic subjects but who show aptitude towards technical subjects will be encouraged to complete an additional year of schooling for a three-year technical diploma.

Under an industrial co-operative plan, students may spend alternate 13-week periods in college and in industry. To accommodate more students, Waterloo will operate on a full time basis for 12 months a year.

Post-Tensioned Piling

A total of 660 post-tensioned concrete piles are being driven in the initial stages of construction for a new factory for British Nylon Spinners, at Bayswater, Victoria, Australia. Designed by Stephenson and Turner, Architects, in association with Scott and Wilson, Kirkpatrick and Partners, of London, the $12 million factory will rest on 14 in. square post-tensioned piles varying from 40-ft hollow friction type, to 65-ft solid bearing type. The Freyssinet system of tensioning is being used. Monocrete Pty. Ltd. is manufacturing the piles on the site.

Sugar Storage

At Mackary, Queensland, Australia, the first of a series of bulk sugar export terminals is being erected at a cost of $3,650,000. The bulk storage shed is 995 ft long, 150 ft wide, and will store 150,000 tons of sugar. Consulting engineers are MacDonald, Wagner & Proddle, in association with the Colonial Sugar Refining Co., Ltd.

Maps for Morale

Special maps of the world are being posted in French factories to boost employee morale and productivity. The maps show 700 major French engineering projects now underway or recently completed in 73 countries of the world, and list 20 world records set by the French in technical achievements around the world.

Transparent Plastic

A new plastic-rot-proof, ageless, colorless, odorless, non-toxic, and as transparent as cellulose, has been brought out by Societe La Cellophane of Paris. It is a linear polymer obtained by the condensation of terephtalic acid and ethylene glycol which is stable between 76 and 302 F. Resistance to acids (except concentrated sulfuric acid) is good, to bases somewhat less, but to oxidizing agents and organic compounds (except phenol) very high. Mechanical strength, dielectric constant, and loss factor are good, making it suitable for the insulation of motors, wires, and cables, for sound-proofing and metallic coating. Since it retains its transparency under normal conditions,

The payoff's in the plating...

Now, aluminum is first choice as an electrical conductor. The Westinghouse electrolytic process of silver plating guarantees performance previously obtainable only with copper.

And Westinghouse offers aluminum bus duct at a reduction in cost from 15 to 25%. This top-quality duct weighs as much as 35% less, too. Because it's aluminum it's easier to handle, install or move.

A technical explanation of this plating process is yours for the asking. Write Westinghouse, Box 868, Pittsburgh 30, Pa., for B-7003. Or see your Westinghouse distributor. J-30231

YOU CAN BE SURE... IF IT'S Westinghouse

FOR BETTER MARKETING—

in B&O's Land of Big Opportunity

The nation's growth statistics prove the B&O area is the focal point of population weight and the center of the top industrial areas—with the lion's share of Standard Metropolitan Markets.

For distribution purposes this means B&O's Land of Big Opportunity provides *front-row* spots for your plant. We can show you an acre or a thousand, strategically placed to better your national distribution.

Look them over with a B&O plant-location man . . . or see them *at your desk* in *3-dimensional color* and *air views. Ask our man!*

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From the B&O RAILROAD, BALTIMORE 1, MD.

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Constantly *doing things* — better!

it can take the place of shatterproof glass.

Aid to Southern Italy

The International Bank has granted Italy a new loan of almost $75 million to be used by the Cassa del Mezzogiorno in the economic development of southern Italy. The new loan brings to $165 million the loans extended by the Bank for this purpose.

Chief impact of the loan will be felt in Sardinia, where $25 million has been earmarked as a 30 percent contribution toward construction of a 42 million cu yd artificial lake that will irrigate some 123,000 acres around Cagliari.

Private enterprise will also benefit. Fiat will get $4.8 million for a new assembly plant in Naples (Capacity, 30,000 vehicles annually); Viberti will build a plant in Naples with its share of $1.3 million. It will turn out 900 buses and 500 trailers per year.

Other firms that will benefit from the loan are St. Gobain of Caserta (glass: $4 million); Forino, at Nocera Inferiore (canned goods: $900,000); Societa Chimica del Tirreno at Sessa Aurunca (fertilizers: $2½ million); A.B.C.D., Ragusa (refining and cement: $5 million); Novilegni (plywood panelling: $900,000); and Italcementi, Sardinia (cement: $2¼ million).

Automatic Translator

A Russian designed electronic computer that automatically translates texts from English into Russian is said to have been developed at the U.S.S.R. Academy of Sciences. The monthly periodical of the Academy gives a complete, illustrated description of the word memory system and grammar coding principles employed by the robot translator, as designed by the Russian scientist, Lebedev. Samples of translated text are given both in the original English and in the Russian equivalent the computer turns out.

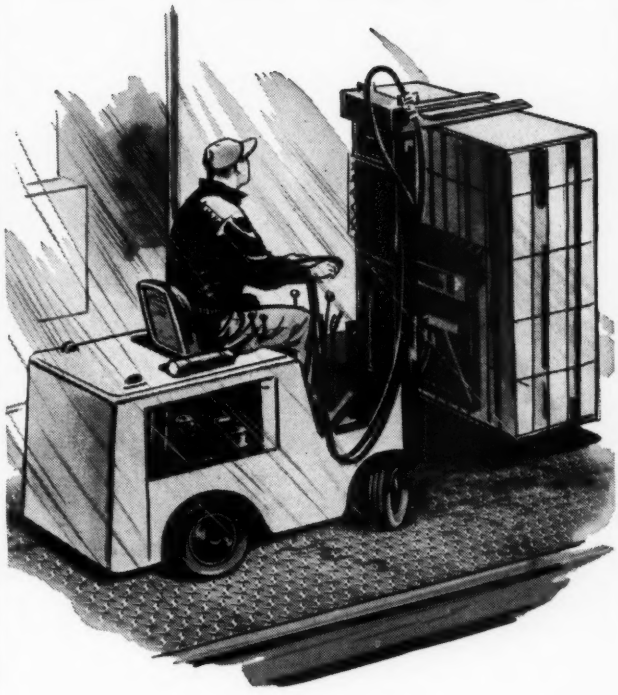
When Bigger Buckets Are Built . . .

Russian coal mining engineers claim to have developed a dinosaur sized "walking excavator," with a 330 ft boom and a bucket of 32 cu yd capacity that can dig 40 to 50 tons of coal per bucket

LOW COST DIFFERENCE BETWEEN

SKID

NO SKID



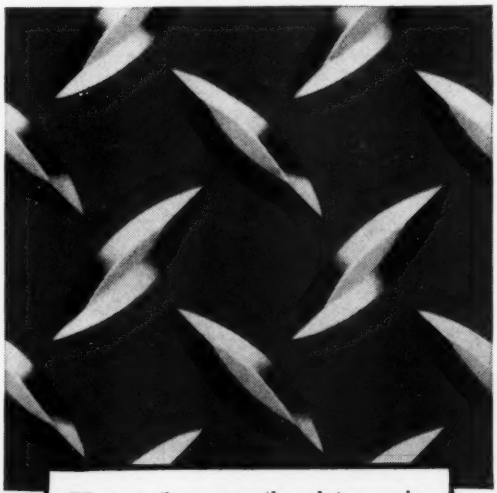
A.W. Super-Diamond rolled steel floor plate

- raised steel figures *diamond-shaped for maximum slip-skid resistance from all approach angles.*
- tough rolled steel floor plate for maximum industrial wear.
- non-directional pattern—no matching problems—minimum waste.
- easily fabricated with ordinary shop equipment for rapid installation.
- no maintenance problems—cleans, drains rapidly.
- use as independent flooring, structurally or as overlay.

For complete information write on company letterhead to Dept. SD-S11.

No other floor plate can match A.W. Super-Diamond's safety and durability at so low a cost.

Pattern actual size



Wherever oil, grease, or other substances raise special slipping accident hazards, we suggest a check on the special non-slip qualities of A.W. ALGRIP—the world's only abrasive rolled steel floor plate.

A.W. SUPER-DIAMOND
ROLLED STEEL FLOOR PLATE

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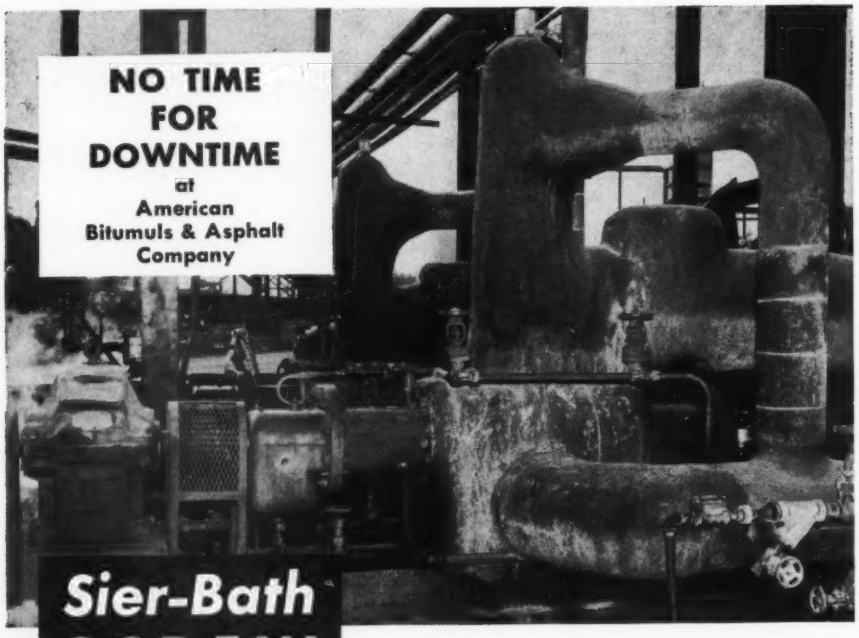
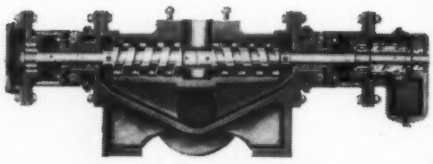


Sier-Bath SCREW PUMPS

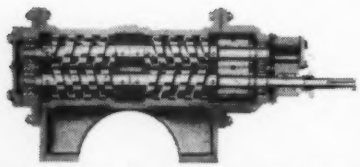
— provide low-cost, reliable heavy-duty pumping service 24 hours a day, 7 days a week

• Shown above are two external bearing type Sier-Bath Screw Pumps at the Cincinnati refinery, charging low gravity crude oil to an asphalt unit. These steam-jacketed pumps have been handling crude oil with a viscosity of 10,000 SSU at 100°F. in 'round the clock operation for a period of 2½ years, with minimum routine maintenance.

Sier-Bath SCREW PUMPS



External Gear and Bearing Bracket Type for non-lubricating liquids and semi-liquids



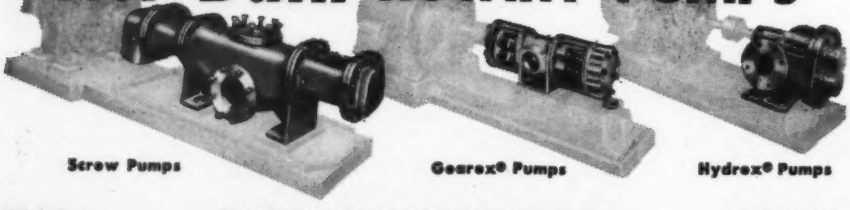
Internal Gear and Bearing Type for lubricating liquids and semi-liquids

Sier-Bath Screw Pumps maintain high volumetric efficiency because "Dual-Controlled" precision rotor design prevents rotor-to-rotor or rotor-to-casing contact—provides a continuous flow without pulsation, hammering or vibration . . . without strains, misalignment and wear on rotors, shafts, bearings and gears.

Result: Dependable, uninterrupted pumping service—less downtime—less maintenance—easier servicing—longer pump life—lower overall pumping costs.

Capacities from 1 to 1,000 gpm.; viscosities from 32 SSU to 1,000,000 SSU.; discharge to 1,000 psi. for viscous liquids, 200 psi. for water and light oils. Horizontal or vertical construction. Corrosion resistant alloys, special bodies, stuffing boxes and bearings for special needs. Call your Sier-Bath representative or write Sier-Bath Gear & Pump Co., Inc., 9257 Hudson Blvd., North Bergen, N. J.

Sier-Bath ROTARY PUMPS



Screw Pumps Gearex® Pumps Hydrex® Pumps

50th Anniversary Mfrs. of Precision Gears, Rotary Pumps, Flexible Gear Couplings Member A.G.M.A

lift. Designed for use in open pit mining of Siberian coal, the new outsized mechanical shovel is capable of replacing 7000 men, excavating to 328 ft, and delivering coal or ground 646 ft from the mine face in under two minutes.

Prestressed Concrete Congress

The International Congress on Prestressed Concrete has decided on Berlin as the base for its next meeting, to be held May 5-10, 1958. Four subjects will be covered in the working sessions:

1. Development in design methods. (Contributions dealing with experimental work on shear stresses particularly requested.)
2. Advances in technique of site work, with particular reference to grouting, anchorages, reduction of friction, and safety measures.
3. Progress in manufacture of prestressed concrete units in factories and use and assembling of precast units on the site. (Contributions from manufacturers and users describing their work are requested.)
4. Buildings and structures carried out wholly or partly in prestressed concrete since the 1955 Congress, in which important developments in design or construction have been included.

Contributions to the Congress on the first three themes should be sent not later than August 15, 1957, to P. Gooding, General Secretary, Federation Internationale de la Precontrainte, Administrative Office, Terminal House, 52 Grosvenor Gardens, London, S.W. 1, England.

Papers on the first three themes must be in English, French, German, or Spanish, and must contain a brief summary in all four languages. Six copies are required. Papers are not to exceed 4000 words in length, including space required for pictures and graphs.

Contributions on the fourth theme should be sent to the General Secretary before October 1, 1957, in triplicate.

Applications for participation in the Congress and for copies of papers presented are available

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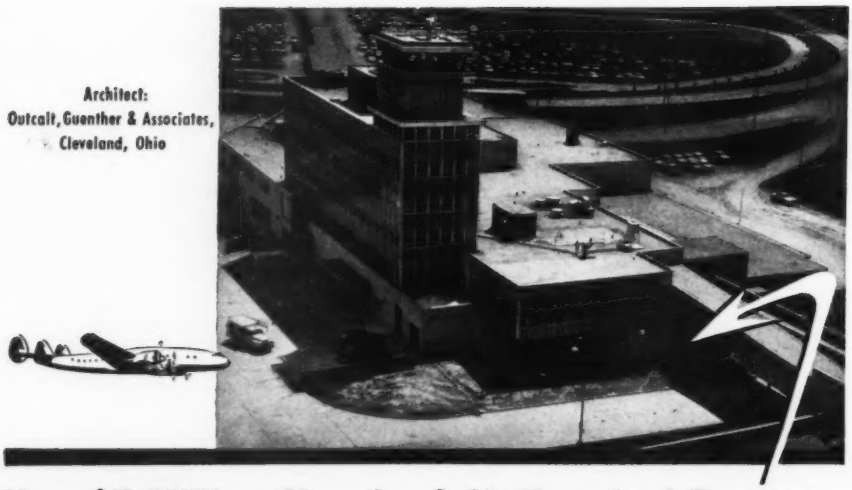
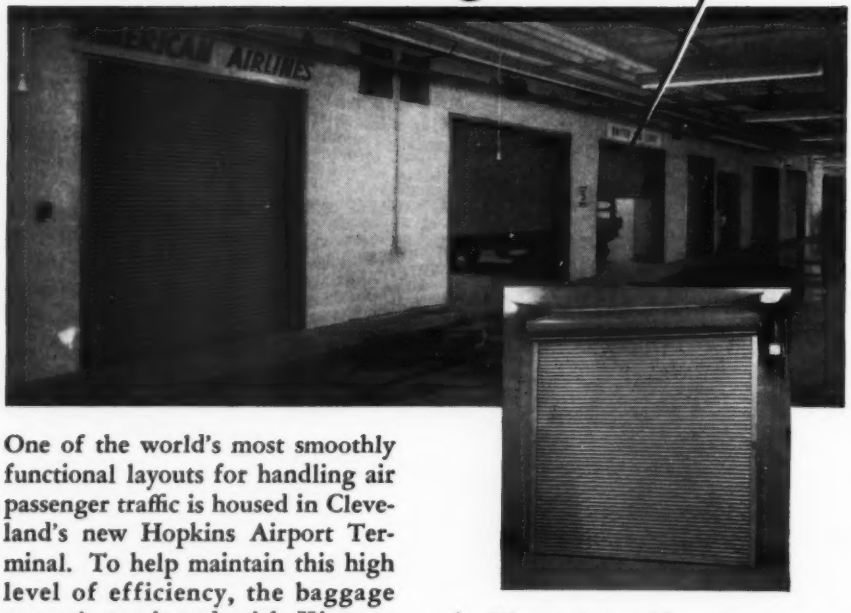


New $5 Million Cleveland Air Terminal Features Kinnear Rolling Doors



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Economic Development in Ceylon

A variety of economic development projects in Ceylon will receive assistance from Colombo Plan funds ($2 million) provided by Canada during the fiscal year 1956-57. An aerial survey of Ceylon's natural resources, begun in 1955, will be continued with $336,000 of the fund, bringing Canada's total contribution for this project to about $500,000.

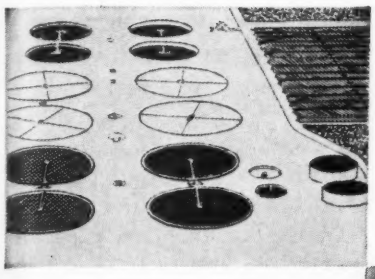
Electrical transmission lines costing $400,000 will be provided for the Gal Oya Valley, where the Ceylon government is re-settling people from the more crowded parts of the island.

In addition, Canada will continue sending shipments of flour to Ceylon, for which the Ceylon government establishes counterpart funds of rupees to be used for agreed economic development purposes. The projects to be financed this way include a veterinary building for the University of Ceylon, a building for a trade school, and the construction of rural roads.

Canada will also contribute $50,000 for assistance to a polytechnic school in Singapore, to be a center for advanced commercial and engineering training for students from the whole of the South-east Asia area. The grant of $50,000 is to equip a section of the school which would be identified with the Canadian gift. This will be the first assistance of a capital nature provided to Singapore from Canada under the Colombo Plan.

Portable Drilling Equipment

International Petroleum (Columbia), Ltd. has imported Columbia's first portable drilling equipment for use in exploring concessions in the Magdalena Valley. The rig is mounted on four trailers that can be moved from one site to another without dismantling the derrick. The derrick itself is telescopic, and about 120 ft high. Drilling equipment, mud pumps, pulleys, piping, a 4½ in. pipe that can go to a depth of 6000



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- *Speeds*–higher speeds develop same cfm in smaller units, reducing weight, floor space, first cost.
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For design information and specification data, ask for Bulletin RB-154 or call your Roots-Connersville Field Engineer.

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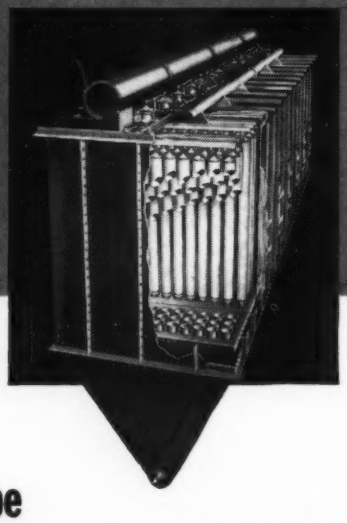
Dust and Fume Collection by Norblo

helps you achieve efficiency and cleanliness in your plant



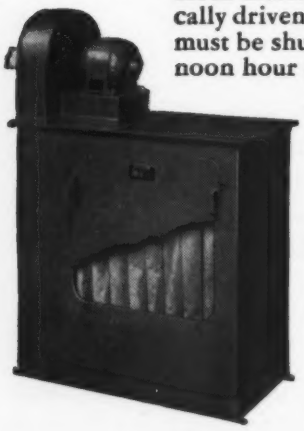
Norblo has developed bag type dust collection systems to a high degree of efficiency.

Norblo Automatic Bag Type

For continuous and heavy duty service at constant capacity and efficiency, Norblo Automatic Bag Type collection pays its own way — in recovery of valuable materials or removal of injurious or "nuisance" industrial air contaminants. Norblo builds the entire installation, from blowers to bag-cleaning mechanisms. Complete systems are engineered to meet specific situations. Norblo engineering insures low maintenance and no shut-downs — guarantees performance of every installation.

Norblo Standard Bag Type Collectors

Based on the same construction principles, the standard bag type collectors provide at low cost the high efficiency service that is obtainable only from bag-type cloth filtering, with either compressed air or electrically driven periodical bag shaking and cleaning. Units must be shut down for cleaning — at such times as the noon hour and end of working day.



Norblo Portable Type

For excellent results in localized dust control, Norblo Portables protect equipment and reduce maintenance in grinding, polishing and cutting departments. Six models cover capacities from 300 to 1350 cfm., at 8″ static pressure at the fan. Occupy small space. Are unusually quiet.

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ft, and all other implements are included. Three diesel engines of 195 hp each move the equipment.

More Steel for U.S.S.R.

Half of the 23-million ton expansion in annual output planned for the U.S.S.R. steel industry in the current construction program is expected to come from improved production methods, among them oxygen blast, continuous pouring, and automation. New steel making capacity is to account for the remaining half in production boost.

Under the program, 40 percent of all Russian made steel produced in 1960, including the entire output of converter steel, is to be from furnaces using oxygen blast methods which reportedly have increased output from 20 to 40 percent. Ladles of 50 to 125 ton capacity are planned for mills operating on a continuous pour basis.

Prestressed Concrete Dam

Britain's first dam built with prestressed concrete required 40 percent less concrete than those built by conventional methods. Cost savings amounted to over $200 per ft of the length. The dam is anchored to the bedrock of the valley by steel bars. A pull of 37 tons was applied to each bar, binding the top of the dam to bars anchored in the rock. The dam is 73 ft high and 1360 ft long.

Mineral Survey

More than 35,000 miles of unexplored jungle in Malaya are being surveyed for mineral deposits in the first major Colombo Plan project undertaken by Canada in that country. Malaya is already a major source of the world's tin and it is hoped that this aerial search will lead to discovery of important new deposits of tin as well as of other minerals, such as tungsten and ilmenite.

The survey is being conducted with a plane equipped as a "flying laboratory." Instruments include a magnetometer and a scintillation counter. Aerial photos will be used in preparing the survey flight maps and intensive ground studies will then be made of areas that the survey indicates may contain important mineral deposits. ▲▲

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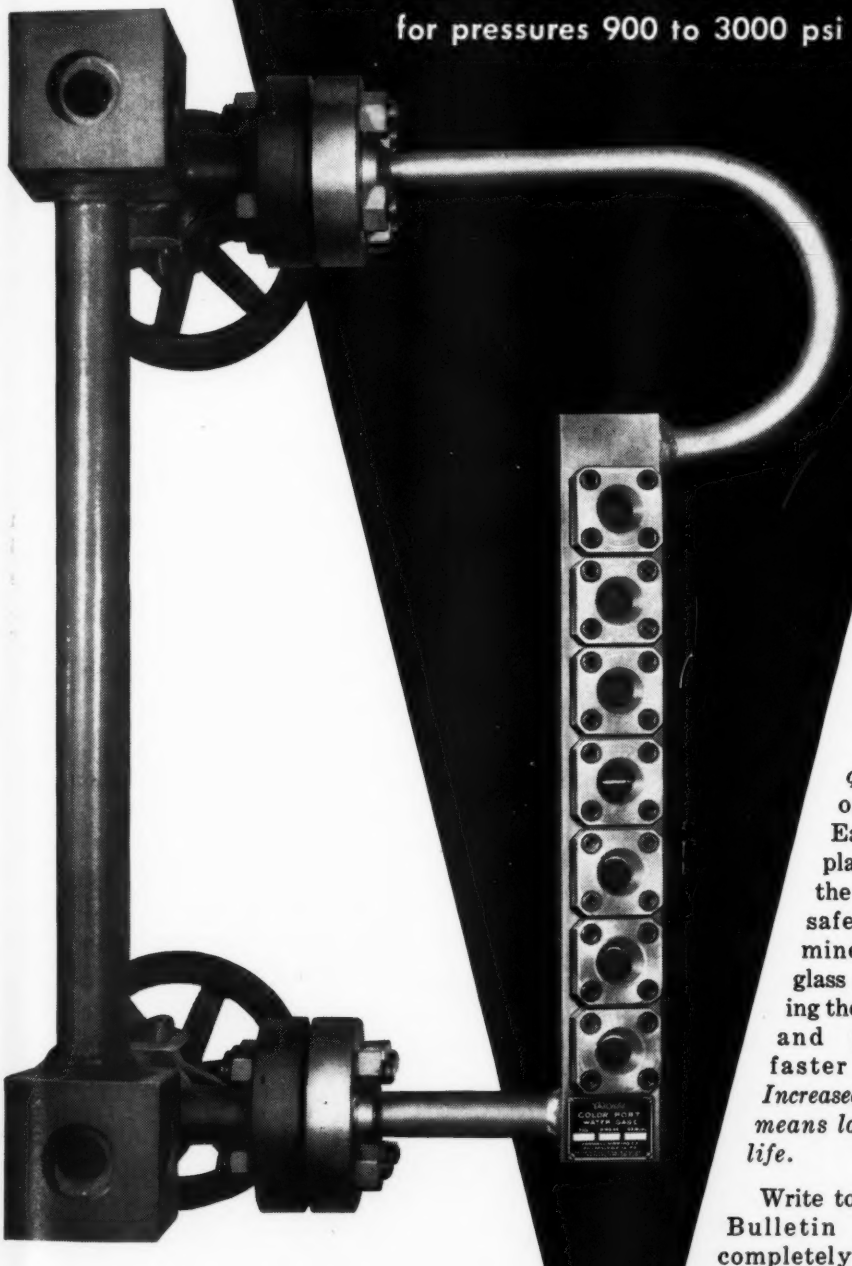

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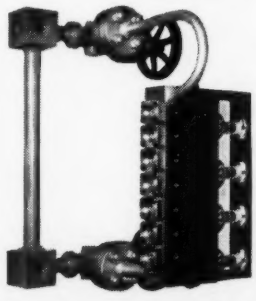

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PREPARING TO CAST A FLOOR IN ONE OF THE THIRTEEN-STORY BRICK APARTMENTS IN BERN.

How We Design High Brick Buildings

JAKOB SCHNEIDER
Consulting Engineer
Bern, Switzerland

A NEW ERA in brick masonry construction may be with us. Three, 13-story buildings constructed with load-bearing brick walls have just been completed in Bern, Switzerland. Prior to the drawing of the preliminary plans for these buildings, in 1953, relatively little research had been done in this field of engineer-

WORKMEN LINE UP THE FIRST COURSE OF A BRICK WALL ON AN UPPER FLOOR. NOTE THE TYPE OF BRICK.

SKILLED MASON WORK IS AN IMPORTANT PART OF BRICK CONSTRUCTION. TESTING OF BRICK IS VITAL.

THE THREE APARTMENTS ARE OF MODERN DESIGN. THE END WALLS AND FLOORS ARE OF CONCRETE.

SPECIFICATIONS WERE RIGID AND THE ENGINEERS CAREFULLY SUPERVISED ALL WORK ON BRICK WALLS.

ing construction, and even the little that had been done had not been applied. The rules used in designing for brick construction had been purely empirical, based on practical knowledge gradually gathered through many years.

It is surprising that there had not been more scientific investigation of brick as a material of construction, for it is the oldest manufactured building material. The early Romans built extensively with brick, and even today, travelers in central and southern Italy can see brick made in the Roman manner. The raw material is hand kneaded, pressed into molds, and then left in the hot sun for baking. While considerable advance had been made in mechanization of the manufacturing process, basic principles remain the same, and until recently there was no effort to improve the quality of brick and little effort to specify it with more than appearance or general quality classifications in mind.

Fundamental Research

When it was decided to build high, multistory buildings with load bearing brick walls, it was immediately apparent that research was required. Using the old methods it would be possible, perhaps, to build a 10- to 20-story building, but it certainly could not be done without overdimensioning the walls. It could not be done, in other words, economically.

In Switzerland almost all research work required for new developments in the building field is done by the Swiss Laboratory for Testing Materials. This is a branch of the Swiss Technical University of Zurich. For a number of years this laboratory had been doing related work in investigations having to do with the manufacture of brick and tile. Two of the most authoritative publications on brick manufacture came from their investigators.[1, 2] Therefore, when the problem of special designs in brick came up, it was natural to turn to the Swiss Laboratory. A great deal of valuable work was done, and the results were summarized in a booklet, *Building with Brick in Switzerland*, prepared by Department Chief Engineer P. Haller, who was in charge of the research.

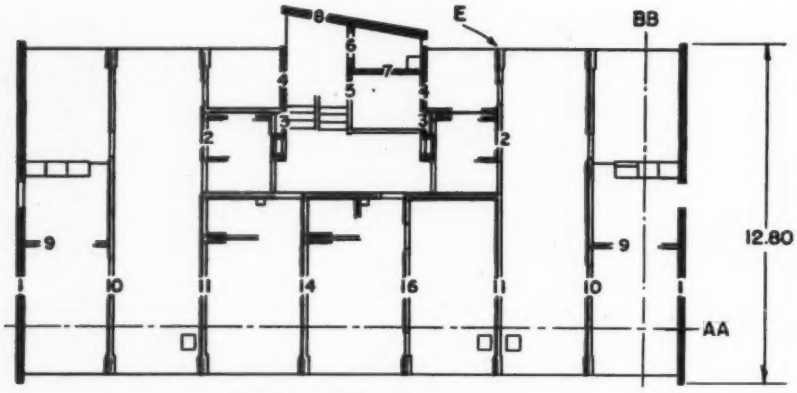
With the results of this research before us, we felt that we could proceed with the design of the three, 13-story apartments for erection in Bern.

Characteristics of the Brick

In building high load bearing walls, the compressive strength of the brick is important. It turns out, however, that it is not the only vital factor. There are in Switzerland a number of brick manufacturers who turn out a product with an amazingly high compressive strength. When testing by crushing bricks 9x15x30 cm in a press, it is not unusual to find compressive strength of better than 7100 psi. Very few of the bricks, however, meet the other requirements established on the basis of the research. It was determined that the brick to be used in a 13-story building should not be over 25-cm (10-in.) thick. It also was found that water absorption was of great importance. Investigation was made of the quality and thickness of mortar, and as would be expected, it was found that the skill of the masons was of paramount importance in building successful load bearing walls of great height.

After a thorough study of the research results, the following specifications were set up for the contractors on the Bern buildings.

¶ No individual brick should differ from the established standard by more than 1 percent. No brick should vary more than 1.5 percent from a middle



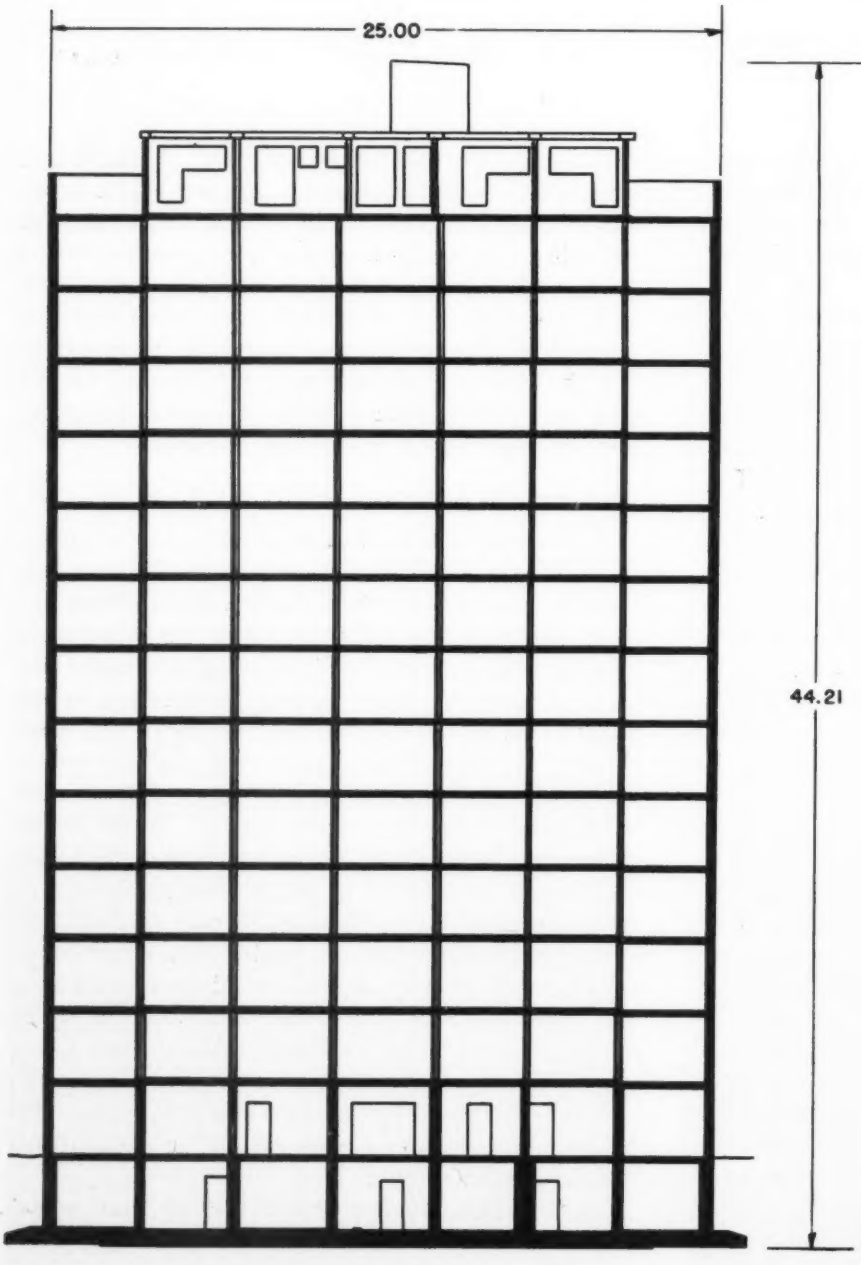
Plan View of 8th Story

THESE DRAWINGS, MADE FROM THE AUTHOR'S ORIGINAL PLANS, SHOW THE DESIGN OF THE APARTMENTS NOW BEING COMPLETED IN BERN. BRICK CONSTRUCTION IS SHOWN HERE IN RED. THE EXTERIOR AND THE FLOORS ARE LARGELY REINFORCED CONCRETE WITH A LITTLE DECORATIVE STONE. DETAILS OF THE BRICKWORK ARE SHOWN IN THE DRAWINGS AT RIGHT. TABLE SHOWS WALL MATERIAL AND THICKNESS FOR EACH OF THE FLOOR LEVELS.

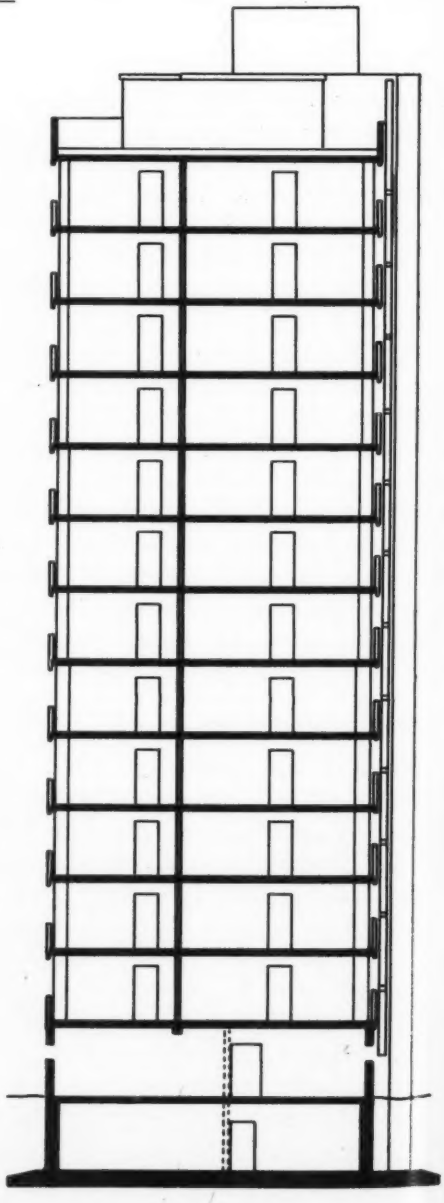
Brick

Reinforced Concrete

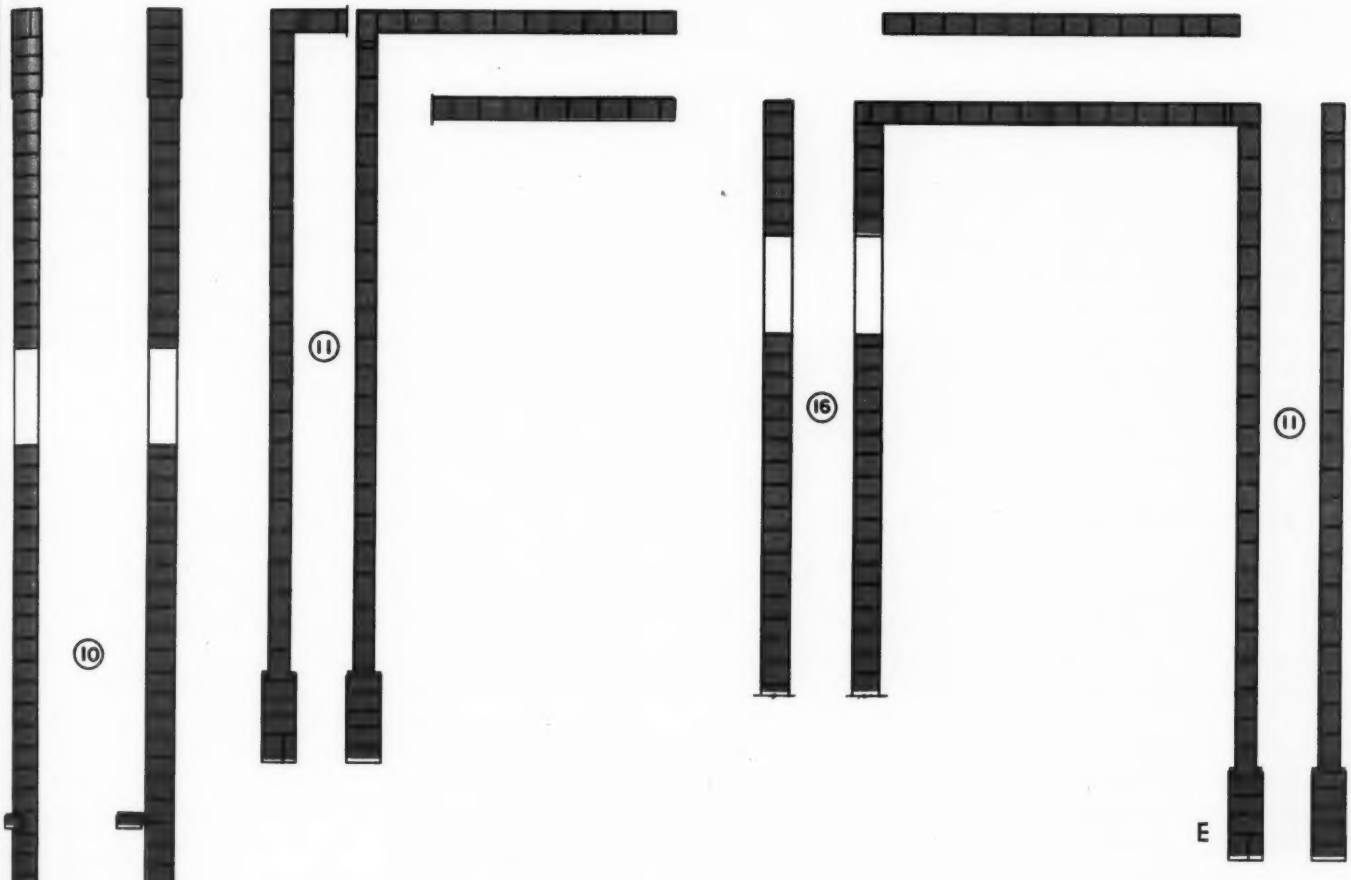
All Dimensions Are in Meters



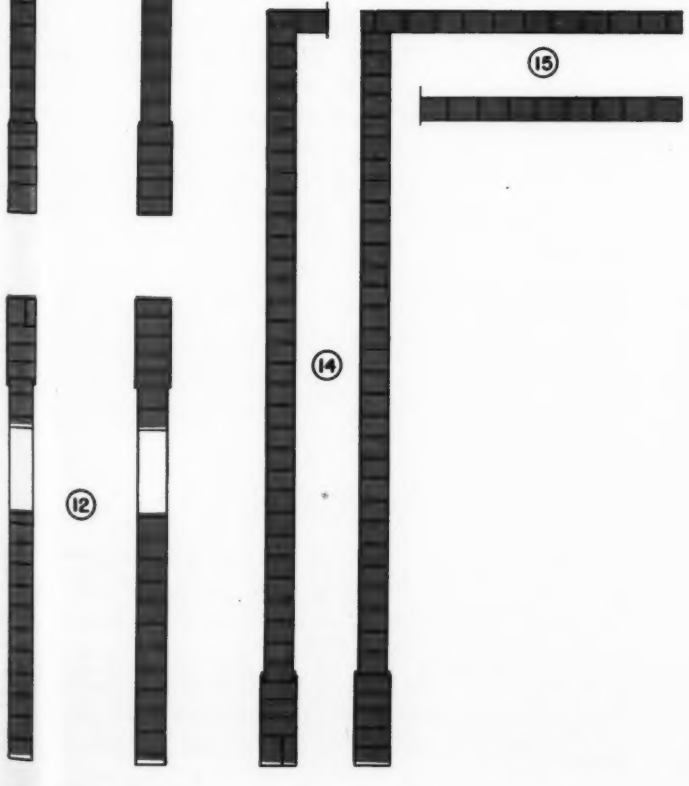
Elevation at Section AA



Elevation at Section BB



Details of Alternate Courses
in the Brick Walls



Wall No.	Floor No.	Wall Material and Thickness
①	1-12	Reinforced Concrete 25 cm
③	1-12	" " 16 cm
④	1-12	" " 18 cm
⑤	1-12	" " 15 cm
⑥	1-12	" " 25 cm
⑦	1-12	" " 12 cm
⑧	1-12	" " 25 cm
⑨	1-12	Brick 12 cm
⑩	1	" 25 cm
	2-7	" 18 cm
	8-12	" 15 cm
⑪	1-7	" 18 cm
	8-12	" 15 cm
⑫	1-5	" 25 cm
	6-8	" 18 cm
	9-12	" 15 cm
⑭	1-5	" 25 cm
	6-8	" 18 cm
	9-12	" 15 cm
⑮	1-12	" 18 cm
⑯	1-5	" 25 cm
	6-8	" 18 cm
	9-12	" 15 cm
Wall Thickness at the Ends E All Increased to 30 cm		

value established by testing a series of six samples.
¶ No bricks with fissures or any other types of faults could be accepted.
¶ All bricks must have a compressive strength of 4267 psi, with a tolerance of not more than 20 percent from the middle value. This means that in no instance should this strength be less than 3415 psi.
¶ The absorption capacity of the brick should not exceed 15 grams per square decimeter per minute. This is equivalent to about 1 gram per square inch per minute using usual U.S. suction rate units.

The acceptance of all brick was up to the engineer, and brick failing to meet these specifications was not accepted for the job.

Construction Specifications

The mortar also was subjected to rigid specifications. The sand used was required to be absolutely free of clay particles and the granulometric composition followed the Fuller-line. Only Portland cement was used, and it was added to the mix at no less than 21.8 lb per cu ft so as to attain a compressive strength of at least 2847 psi at 28 days, with a tolerance from the middle value of not more than 20 percent. This compressive strength was based on tests made on cubes of 4 cm to the side.

The engineers also issued special instructions to the contractors. It was required that all bricklaying be done with utmost care with all work done by the best qualified masons whose skill had to be approved by the engineers. Mortar joints were not to exceed 12 mm (0.5 in.) in thickness and were to be filled with mortar throughout. Once set in a mortar bed, a brick was not to be moved again.

Under no conditions were workmen allowed to pick holes or channels out of the finished wall for the purpose of hiding pipe or conduit. Wherever holes were necessary, a special permit was required from the engineer, and special tools were used.

The contractor was required to pay the cost of any work that had to be done over because the specifications were not followed.

Future Plans

Admittedly, these specifications were severe and hard to follow. In fact, we had to make allowances in several instances. However, we made no concessions on major points, for we expect to build even higher buildings with load bearing brick walls, and we wanted to see how well such rigid specifications could be followed. The higher the buildings, the more important it is that the specifications be followed to the letter. We also wanted to prove that brick is a much better engineering material than most engineers realize. We had to show them that it is economically competitive to reinforced concrete construction in this part of the world.

The three, 13-story apartment buildings we built in Bern are now ready for occupancy. They are each of the same type with only minor differences in detail. The principal features are shown in the drawings and photographs. Particularly interesting is the almost total absence of lateral stiffening in the walls.In most buildings of this general type, the plan design is divided into rooms through a network of walls in two directions and at comparatively short distances. In this design the walls run primarily in one direction, with no lateral stiffening at the ends and very little in between — except for the stair-wells and elevator shafts. Obviously, this calls for more careful and thorough statistical computations than for normal construction.

Design Criteria

Usual design methods are not permissible. These walls must be designed as members of a multistory frame. The formula for allowable stress must use not only the usual h/t ratio but also must include:
¶ The eccentricity of the load, for determination of which the frame moments must be computed.
¶ Compressive strength and absorption of the brick.
¶ The quality of the mortar used.
¶ The type of wall. In particular, the arrangement of bricks in each course and the overlapping between courses must be taken into account.
¶ The height of the bricks.

For these buildings, calculations for the wall in the 4th story (identified as No. 10 in the drawings) resulted in an allowable stress of 314 psi. This particular wall used 18-cm brick from the second through the seventh floor and 15-cm brick for the floors above. The maximum thickness of any brick used in the building was 25 cm. The drawings give all of the details on dimensions and materials of construction and show the way in which the bricks were laid. All walls of the ground floor are of reinforced concrete as are those of the cellar, but this is for other than structural reasons. These are designed to be used as bomb shelters during times of war.

It should be emphasized that the architect should be brought into the team from the very beginning of the design in a building of this type. Many of the structural problems that arise can be handled easily if taken up at the right moment. When the architect decides late in the design to make some innovation, this will lead to weary discussion and unsatisfactory, less economic solutions. This is true, no doubt, all over the world. ▲▲

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2. *Physics of Brick*, Part II, *(Physik des Backsteins*, 2. Teil), "The Properties of Brick-Masonry" (die Eigenschaften des Backsteinmauerweks), "Thermo-Technical Design," (Warmetechnische Bemessung), by dipl. ing. P. Haller, Zurich, 1951.

Survey of The Profession 1957

Parts II & III

STAFF REPORT

THE RESULTS OF Part I of the "Survey of the Profession — 1957" were published last month, in the January issue of CONSULTING ENGINEER. There were a number of interesting facts determined. It was found, for example, that 27 percent of the firms of consulting engineers are located in the Midwest, 27 percent in the East, 21 percent in the West, 17 percent in the South, and 8 percent in the Southwest. The survey showed that the private practice of engineering is a new and rapidly growing profession with a third of all the firms in the United States less than five years old and almost two-thirds less than ten years old. It also showed that nearly half the consulting firms are under sole ownership, almost a third operate as partnerships, while about 20 percent are corporations, with the percentage of corporations rapidly increasing. As an interesting vital statistic, the average partner or principal is 45-years old and his firm's best income year was last year, 1956. He expects 1957 to be even better.

Part II of the survey deals with a different field of inquiry. The first question asked was, "When your firm was first organized, what type of work did it do?" Table 1 gives a compilation of the answers received. It is significant that most consulting firms (98 percent for the U.S. as a whole) started in business as consulting engineers, not as contractors, manufacturers, sales representatives, or architects. A few did start in one of those fields, changing later to private practice, but most of those were contractors who added an engineering department or architects who added engineers to their staffs to become architect-engineers.

When first organized, 6 percent of the consulting engineers did both engineering and contracting for construction, and about 14 percent were originally organized as architect-engineer firms. This means that 80 percent of the firms, when first founded, engaged only in straight engineering services.

Table 1 also compares status when first organized with current operations. Note that today, 9 percent of all firms of consulting engineers also do contracting for construction. This is an increase over the 6 percent who did contracting when first organized, but it still means that better than 9 out of 10 firms of consultants deal only in services. On the other hand, today 20 percent of all firms of consulting engineers also do architecture to some extent. This ranges from one architect working with a large staff of engineers to a fully staffed architectural department. There would seem to be a recognizable trend toward the combining of both services in one firm with the larger firms showing a higher percentage of combined professional services.

There is little difference between regions of the country in this respect. However, the East does show a slightly higher than average percentage of firms offering contracting and architecture. From this one can assume that the "Package" project is a little more common in the East than elsewhere. Pennsylvania is particularly high in the percentage of engineers who will handle contracting and architectural work. New York's figure of 9 percent who do contracting probably is held down by the law prohibiting corporate practice for any firms not in business there prior to 1935.

The questionnaire went on to ask whether any change in type of work was contemplated. Only 3 percent plan any change. Most of these plan to add architecture to the work done by the firm. The other proposed changes in type of work were individual

TABLE 1—TYPE OF WORK IN WHICH FIRM ENGAGED

State	When Founded			Currently		
	Engrg. Serv. %	Contracting %	Architecture %	Engrg. Serv. %	Contracting %	Architecture %
Alabama	100	14	7	100	14	7
Arkansas	100	0	0	100	0	0
Florida	100	8	20	100	8	28
Georgia	100	10	0	100	5	17
Kentucky	100	0	14	100	0	14
Louisiana	100	0	15	100	0	15
Mississippi	—	—	—	—	—	—
Missouri	100	9	13	100	13	26
North Carolina	93	0	20	100	0	33
South Carolina	—	—	—	—	—	—
Tennessee	85	10	15	100	15	8
Virginia	100	0	45	100	—	55
West Virginia	—	—	—	—	—	—
SOUTH	97	5	15	100	6	22
Illinois	98	8	24	100	12	28
Indiana	100	7	33	100	7	53
Iowa	100	10	20	100	0	40
Kansas	100	0	0	100	0	0
Michigan	98	12	19	100	14	28
Minnesota	97	0	3	100	3	10
Ohio	100	1	19	100	3	21
Wisconsin	100	0	22	100	5	22
MIDWEST	99	5	19	100	7	24
Arizona	90	0	10	100	10	20
New Mexico	100	0	0	100	—	10
Nevada	—	—	—	—	—	—
Oklahoma	94	12	0	100	12	19
Texas	98	5	12	100	5	20
SOUTHWEST	96	5	10	100	6	19
Connecticut	92	17	8	100	17	8
Delaware	—	—	—	—	—	—
Dist. of Columbia	95	5	5	100	15	5
Maine	—	—	—	—	—	—
Maryland	100	10	—	100	10	10
Massachusetts	100	13	7	100	13	0
New Hampshire	—	—	—	—	—	—
New Jersey	95	5	5	100	20	5
New York	98	6	10	100	9	18
Pennsylvania	98	12	14	100	20	27
Rhode Island	—	—	—	—	—	—
Vermont	—	—	—	—	—	—
EAST	98	8	10	100	14	27
California	95	4	11	100	6	18
Colorado	100	14	19	100	10	19
Idaho	100	0	20	100	20	20
Montana	—	—	—	—	—	—
Nebraska	100	0	0	100	0	20
North Dakota	100	0	25	100	0	25
Oregon	100	22	22	100	22	22
South Dakota	—	—	—	—	—	—
Utah	100	0	30	100	0	30
Washington	97	3	10	100	3	23
Wyoming	—	—	—	—	—	—
WEST	97	5	13	100	7	19
TOTAL U. S.	98	6	14	100	9	20

situations and did not indicate any trend. However, the fact that none of the firms plan to change from straight engineer to engineer-constructor is significant. This means that new engineer-contractor firms will come about as the result of contractors who add engineering departments rather than engineers who expand to include construction work.

Fields of Engineering Activity

The survey showed that about two-thirds of all consulting engineer firms practice in more than one field of engineering. Many are in all major branches and will take on special assignments in related areas. As might be expected, the mechanical-electrical and the civil-structural combinations are most common. Table 2 gives a compilation by states of the percentage of the firms engaged in each branch. For the United States as a whole, 55 percent of the firms do mechanical work, 51 percent civil, 50 percent electrical, 46 percent structural, 9 percent chemical, and 27 percent other special engineering.

When these figures are compared with those for the same firms when first organized, it can be seen that there has been a strong trend toward diversification of activity. The percentage doing mechanical work has increased from 46 percent to 55 percent, for example. This is a natural evolution, for as a firm gets larger and more prosperous, it is likely that a new partner or new employees will be added to expand the fields of activities. Every branch of engineering shows a percentage increase similar to that for mechanical. With the trend toward larger organizations, this increased diversification can be expected to continue.

It is interesting to note that the East leads in the percentage of firms doing mechanical (62 percent) and the percentage doing chemical (13 percent). The West leads other regions in the percentage of firms engaged in civil (56 percent) and structural (51 percent). This high percentage of structurals in the West is heavily weighted by California, where there is a separate licensing examination for that branch.

The table shows that 27 percent of the firms said that they did engineering in other than the major branches listed. An examination of the questionnaires showed that these specialized fields cover a wide range extending from nuclear engineering to mining and marine work. Quite a number listed sanitary engineering separately rather than as a branch of civil. If sanitary were considered as a branch of civil, this would raise, by a few points, the percentage of firms practicing civil engineering.

If the figures for the U. S. as a whole are analyzed, they indicate that the average firm of consulting engineers practices in 2.4 branches of the profession, and this diversification figure is increasing. In fact, better than 5 percent of the firms have definite plans for further diversification. While many primarily civil firms plan to go into mechanical and

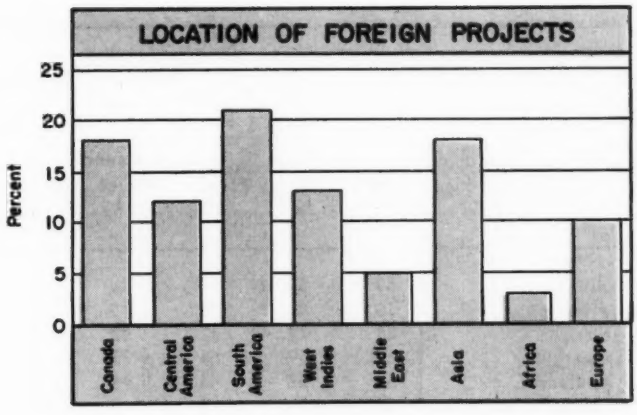
electrical and many mechanical-electrical firms plan to add civil and structural, there is an impressive trend toward nuclear work and highway and bridge design. The addition of nuclear engineering is to be expected and probably will increase in the future at an even faster rate. The swing to highway engineering is the result of the new federal highway program.

Geographical Range

The survey shows that consulting engineers are greatly expanding their geographical range. Table 3 gives a compilation of results by regions of the United States. It also compares the scope of operations of firms when first organized with their current operations. The broadened geographical range of projects is clear. When first organized 53 percent of the firms in the United States operated only within their own state, and 92 percent worked entirely within the United States. Only 8 percent of the firms engaged in foreign work. Today, the situation is quite different. Only 28 percent of the firms limit themselves to operation within one state, 72 percent operate within the borders of the United States, and 28 percent do foreign work. Better than a fourth of U.S. engineering firms, in other words, have experience on foreign projects.

This geographical expansion will continue. In fact, 12 percent indicated that they plan to expand further their geographical fields of operation. Of these, about two-thirds indicated that they planned to changed from intra- to inter-state operation, while one-third plan to go into foreign work. A very few, less than 0.5 percent of the engineers in the country, plan to decrease their foreign work.

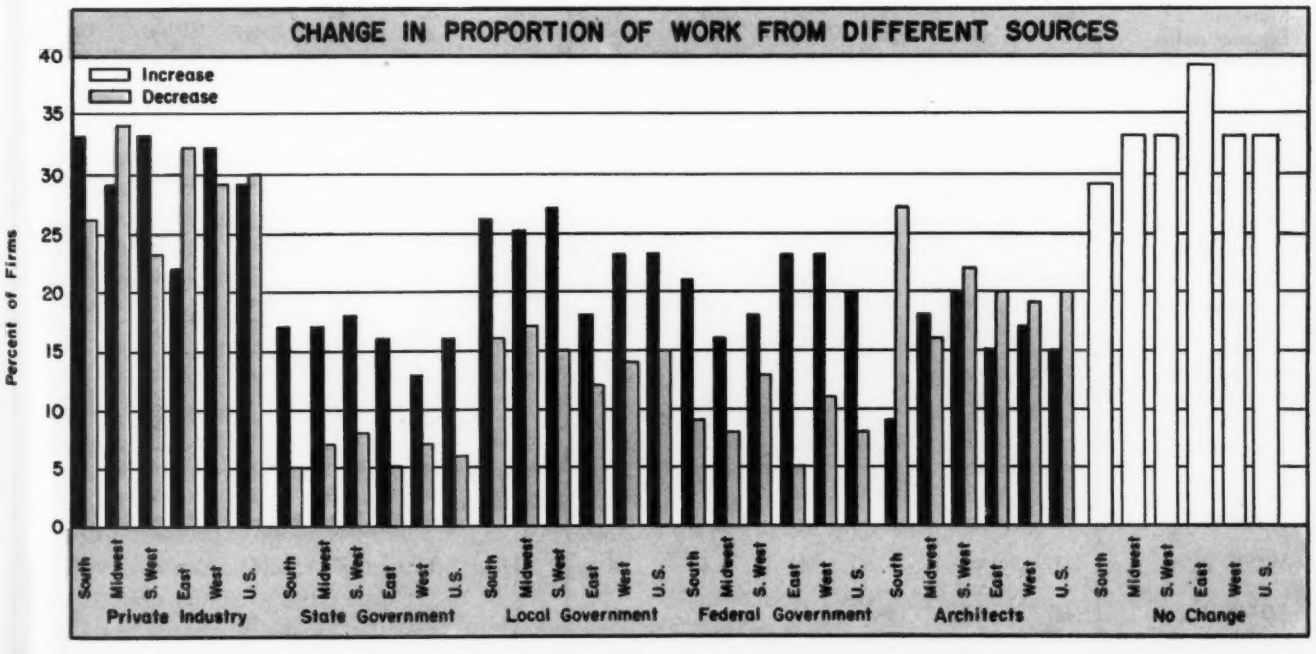
Consulting engineers from the United States have



worked in almost every major country in the world. Of those who have done foreign work, 18 percent have worked in Canada, 12 percent in Central America, 21 percent in South America, 13 percent in the West Indies, 5 percent in the Middle East, 18 percent in Asia, 3 percent in Africa, and 10 percent in Europe. South America leads in popularity with Canada only a little behind. It is surprising, however, that as many as 10 percent of those who have done foreign work have had projects in Europe. This means that almost 3 out of every 100 consulting firms in the U. S. have worked in one or more European countries.

Who Are the Clients

While a few—very few—engineers work primarily for other engineers, almost all work comes from some combination of five sources: private industry, state government, local government, federal government, or architects. Almost 9 out of 10 consulting firms (88 percent) work for private industry to



PERCENT OF FIRMS WITH AN INCREASE OR A DECREASE IN THE PROPORTION OF WORK FROM SOURCES INDICATED.

TABLE 2 — FIELDS OF ENGINEERING ACTIVITY

State	When Founded						Currently					
	Mech. %	Civil %	Elect. %	Struct. %	Chem. %	Other %	Mech. %	Civil %	Elect. %	Struct. %	Chem. %	Other %
Alabama	50	50	36	36	0	0	57	64	50	43	7	0
Arkansas	14	86	20	14	0	0	14	86	29	14	0	0
Florida	28	72	32	52	12	32	40	84	40	68	6	40
Georgia	12	39	55	39	0	0	45	50	72	61	11	22
Kentucky	57	57	43	43	14	43	57	57	43	28	14	43
Louisiana	55	30	65	40	15	0	60	35	65	40	5	30
Mississippi	—	—	—	—	—	—	—	—	—	—	—	—
Missouri	29	54	25	54	4	25	42	54	33	54	8	29
North Carolina	67	47	47	40	7	13	87	40	80	53	7	27
South Carolina	—	—	—	—	—	—	—	—	—	—	—	—
Tennessee	42	67	33	58	0	17	41	75	50	75	0	17
Virginia	63	63	63	36	9	0	81	63	81	54	18	36
West Virginia	—	—	—	—	—	—	—	—	—	—	—	—
SOUTH	40	49	40	40	6	13	50	54	49	48	9	24
Illinois	52	44	48	42	4	32	62	62	42	52	10	42
Indiana	40	60	40	54	0	13	60	65	65	60	0	33
Iowa	30	80	50	70	10	40	30	80	50	80	*50	10
Kansas	62	37	75	25	0	25	63	63	85	37	12	37
Michigan	46	53	33	40	5	23	60	56	46	49	7	28
Minnesota	42	62	48	23	6	16	48	67	48	35	13	22
Ohio	55	31	40	30	3	33	57	35	47	35	7	37
Wisconsin	63	32	53	32	5	27	63	37	63	37	5	21
MIDWEST	50	45	44	36	4	27	57	54	50	44	10	32
Arizona	0	40	10	40	10	30	10	50	20	60	0	40
New Mexico	40	20	40	20	10	0	50	10	50	20	10	0
Nevada	—	—	—	—	—	—	—	—	—	—	—	—
Oklahoma	56	56	56	50	0	13	62	68	56	62	6	44
Texas	58	39	49	24	7	27	73	59	73	42	12	32
SOUTHWEST	47	42	43	32	6	20	58	53	58	45	9	31
Connecticut	43	35	50	36	7	14	50	50	57	43	7	14
Delaware	—	—	—	—	—	—	—	—	—	—	—	—
Dist. of Columbia	60	35	65	35	10	20	65	35	85	30	15	25
Maine	—	—	—	—	—	—	—	—	—	—	—	—
Maryland	63	27	45	54	0	18	63	36	45	54	0	9
Massachusetts	47	40	28	40	13	40	54	40	33	40	7	45
New Hampshire	—	—	—	—	—	—	—	—	—	—	—	—
New Jersey	62	24	33	19	5	19	60	28	43	33	10	19
New York	50	45	41	37	10	22	59	46	49	30	14	24
Pennsylvania	56	32	26	30	10	22	72	40	50	52	16	36
Rhode Island	—	—	—	—	—	—	—	—	—	—	—	—
Vermont	—	—	—	—	—	—	—	—	—	—	—	—
EAST	54	40	39	36	9	21	62	43	52	43	13	26
California	39	39	33	44	4	12	45	51	49	54	4	18
Colorado	41	55	18	54	18	0	46	55	32	46	0	27
Idaho	0	80	0	60	0	60	20	80	20	80	0	80
Montana	—	—	—	—	—	—	—	—	—	—	—	—
Nebraska	20	80	40	40	10	20	60	80	80	80	20	40
North Dakota	25	25	75	0	0	0	25	75	75	25	0	25
Oregon	44	44	22	44	22	0	56	44	22	44	22	0
South Dakota	—	—	—	—	—	—	—	—	—	—	—	—
Utah	40	50	30	40	0	20	40	50	40	50	0	20
Washington	50	53	42	30	3	27	63	63	60	50	10	27
Wyoming	—	—	—	—	—	—	—	—	—	—	—	—
WEST	38	46	33	41	6	14	46	56	45	51	5	22
TOTAL U. S.	46	44	39	38	6	20	55	51	50	46	9	27

TABLE 3 — GEOGRAPHICAL RANGE

	Scope When Organized			Scope Currently		
	Within State % of Work	Within U. S. % of Work	Foreign % of Work	Within State % of Work	Within U. S. % of Work	Foreign % of Work
South	54	97	3	31	83	17
Midwest	61	96	4	32	79	21
Southwest	60	93	7	35	81	19
East	39	86	14	20	58	42
West	61	91	9	27	72	28
UNITED STATES	53	92	8	28	72	28

some extent. Many work for private industry only, but the usual arrangement is to have several sources of work. For the United States as a whole, 28 percent do some work for state governments, 44 percent for local governments, 29 percent for the federal government, and 42 percent for architects. Just as there are a large number of firms who work only for private industry, there are also many who work only for architects. There are, however, very few who limit their clients to government.

In Table 4 a breakdown as to kind of clients for each region of the country is tabulated. Note that the South has the lowest percentage of engineering firms working for private industry, and that region is followed by the Southwest. In the South a much higher percentage of the engineers work for architects, closely followed by the West. The Midwest is very low in percentage doing work for architects. These conditions are not, however, stable. A study of the chart showing change in proportion of work from the different sources shows that 33 percent of the Southern firms are giving more of their time to work from private industry while only 26 percent are giving less, and most of those giving less are turning to state, local, or federal government rather than to architects. A whopping 27 percent of the Southerners are doing less work for architects while only 9 percent are increasing their percentage of work from them. This means that there is a rapid change in the South that will soon have it in line with the rest of the country.

Throughout the whole country there is a strong trend toward government work. This is particularly true for federal government. Today, 29 percent (Table 4) of the engineers in private practice have federal government projects. While the West is ahead in the percent of engineers who do federal work, the proportion is sizable in all parts of the country, and it is growing rapidly. The chart shows a much higher percentage of firms are increasing their work for federal government than are reducing their work for this client. This trend holds true in every section of the country.

The percentage of firms working for state and local governments also shows a marked net increase. Firms having private industry as a client are also on the increase in every section except the Midwest, where there is a strong trend toward government work and a slight trend toward working for architects. This is the only section of the country to show a net gain in percentage of firms working for architects, and this gain is so slight (2 percent) that it could hardly be called a trend.

All of these trends result from changes in activity in about two-thirds of the engineering firms. The remaining third are still devoting their time to work from the different clients in the same proportion as when they first went into business.

In studying these tables and charts, it should be kept in mind that the data represent firms of engineers, not dollar volume of business. With the great increase in dollar volume of work done by consulting engineers in recent years, it is likely that the volume of business done for architects, for example, has actually gone up in all parts of the country. The data shown in the chart indicate only that a lesser percentage of engineering firms are doing work for architects than ever before. The actual dollar value of this work may be, and probably is, increasing.

The mythical average firm, a compilation of all the firms in the United States, does about 38 percent of its work for private industry, 12 percent for state government, 19 percent for local government, 13 percent for federal government, and 18 percent for architects. It is tending to increase slightly the percentage of work for private industry, increase considerably the percentage for governmental units and decrease the percentage of work for architects.

This average firm is of only academic interest, however, for very few actual firms even list among their clients all five sources of work. In fact, the average firm actually works for only 2.3 of the five sources of business.

Advertising the Firm

As might be expected, most engineers do not advertise their firm in any way. The Canons of Ethics state that an engineer shall not engage in any "self-lauditory" advertising, but most engineers

in private practice do no advertising at all. The returns from the survey showed that 83.9 percent say they do no advertising, 8.7 percent advertise only to the extent of professional cards in telephone books and other directories, and only 7.4 percent do advertising in the generally accepted sense. Many of this minority who do advertise are engineer-constructors, who advertise their construction work. Still, there are some independent engineers who buy display advertising. They say that the engineer, unlike the doctor or lawyer, most operate over a wide geographical range, and there is no way he can put his name and qualifications before prospective clients except through advertising in business and management publications.

TABLE 4 — KIND OF CLIENT

	Percent of Firms Working for				
	Private Industry %	State Govt. %	Local Govt. %	Federal Govt. %	Architects %
South	81	23	48	29	52
Midwest	91	34	50	20	28
Southwest	87	39	46	23	43
East	89	25	33	29	42
West	89	23	44	41	50
U. S.	88	28	44	29	42

TABLE 5 — OFFICE SPACE

	When Organized		Currently	
	Rented %	Owned %	Rented %	Owned %
South	91	9	77	23
Midwest	87	13	75	25
Southwest	89	11	71	29
East	84	16	74	26
West	83	17	76	24
U. S.	86	14	75	25
	In Suburbs %	Downtown %	In Suburbs %	Downtown %
South	15	85	47	53
Midwest	31	69	43	57
Southwest	25	75	58	42
East	25	75	37	63
West	28	72	34	66
U. S.	26	74	42	58
	Floor Space sq ft		Floor Space sq ft	
South	575		2825	
Midwest	745		2930	
Southwest	635		2160	
East	725		4020	
West	580		4540	
U. S.	666		3330	

Part III — Offices

What have been the trends in office location, size, and ownership. The survey shows, in Table 5, that 75 percent of all engineers' offices are rented and the remaining 25 percent are owned. The trend is toward ownership, for when first organized, 86 percent were rented and only 14 percent owned. Many of this 14 percent were, no doubt, located in homes. Note that the Southwest shows the highest percentage of ownership (29 percent) and also the highest percentage located in the suburbs (58 percent). These two factors naturally go together, for most downtown space is rented. Currently, 42 percent of the offices in the United States are in the suburbs, while only 26 percent were located in the suburbs when first organized. There is a heavy trend to the open spaces. However, the Southwest is the only region with more engineers' offices in the suburbs than downtown. In the East and West, almost two-thirds are still located downtown. The large cities seem to require that the offices be located downtown — a condition predominant on both the East and the West Coasts.

A study of floor space currently and when first organized gives a good idea of growth. The floor space of the average engineer's office in the United States as a whole has gone from 666 square feet to a current 3330 square feet, an increase of exactly 5 times. This checks rather well with the increase shown for employees in Part I, published in January. Number of persons per firm increased from 4.8 to 31.1. This is an increase of 6.5 times, and this would indicate that things are getting a bit crowded, as every engineer knows.

It would appear that this trend toward office ownership and suburban location is just barely getting under way. The survey showed that 30 percent of the country's engineers plan to make changes in office space in the near future, and the great majority of these plan to build their own buildings in the suburbs. In many instances they plan to build much larger buildings than they need and rent the extra office space.

Part IV Next Month

Originally, it was planned to publish the results of Part IV, dealing with opportunity today for going into private practice, in this issue of CONSULTING ENGINEER, but the comments provided in the questionnaire were so interesting and so important, that it was decided to hold this data for publication in full detail in the March issue. ▲▲

TO THE LADIES

Carefully tear out this page along the dotted line, and take it home for your wife to read this evening.

IT HAS BEEN RUMORED, dear ladies, that your husbands have been keeping something from you. Has your husband been trying, for the past few months, to talk you into spending a month in Europe this spring? Has he been telling you about the tour that has been arranged by this magazine for consulting engineers and their wives, a tour that will take you to London, Dublin, Paris, Milan, Rome, and Madrid? Has he been making a serious attempt to find a baby sitter? Has he invited your mother to spend the month at your house with the children? We doubt it.

He simply may have forgotten to tell you about the tour. He may be keeping it as a surprise. But we are going to tell you anyway.

All arrangements have been made to take a group of about 30 consulting engineers and their wives (15 couples) on a European tour starting from New York on May 11. We will leave International Airport that Saturday night at 6:00 pm, and will be in London the next morning. (Dress for dinner aboard the plane will be informal.) In London we have arranged for a luncheon with a group of British engineers and their wives, and you will undoubtedly have an opportunity to do some shopping with some of these ladies later or perhaps visit at their homes. Interesting tours of the city and dinner and theater parties are all planned. Of course, if you have other ideas of fun, you are free to follow your own devices—husband willing.

Dublin you will love, and Paris, — Paris is just as you want it to be. From Milan you can have a long week-end in Switzerland or on the Riviera. In Rome you can go looking for the shop where Rossano Brazzi worked in *Summertime*. In Madrid, you can keep an eye on your husband to be sure he is not out looking for Ava Gardner.

While it is true that this tour was planned primarily to put your husband and a few of his American colleagues in touch with European engineers in private practice and let them compare professional opinions, we have by no means overlooked you and your interest. Our tour editor has even prepared a booklet that tells you just what clothes you will need and how to pack your bag.

We will be staying at the best hotels, and we have arranged for one of the finest guides in Europe. Last year the ladies all thought he was a dear, and we had to admit that he was a good guide. He knows the best places to shop and the most interesting places to eat in every city in Europe.

Surprisingly enough, while the tour is deluxe in every respect, it is not really expensive.

One of the best things about this trip is that it combines the best aspects of a guided tour with the advantage of traveling alone or with friends. There is a complete itinerary so that you are never left with nothing to do, yet any time you like you can start off with your husband and go wherever you like, whenever you like, and meet the group later along the line. A couple of days alone in the French Provinces may be just what you two need.

Since the group will be very limited in number, and since we have the reservations list more than half full now, it would be a good idea to talk about this tonight, and then mail in the coupon.

Tour Editor, CONSULTING ENGINEER, St. Joseph, Michigan
You are so right. We do want to go to Europe in the Spring.
Send us the details

Mr. & Mrs. .....

His Firm Name .....

Address .....

.....

AERIAL VIEW OF THE RECENTLY COMPLETED, 1422-FT WISNER DRIVE OVERPASS IN THE CITY OF NEW ORLEANS.

Unique Properties and Cost Advantages Promote

Prestressed Concrete Designs

CARL L. BANKSTON, JR., Associate, G. A. Heft & Co.

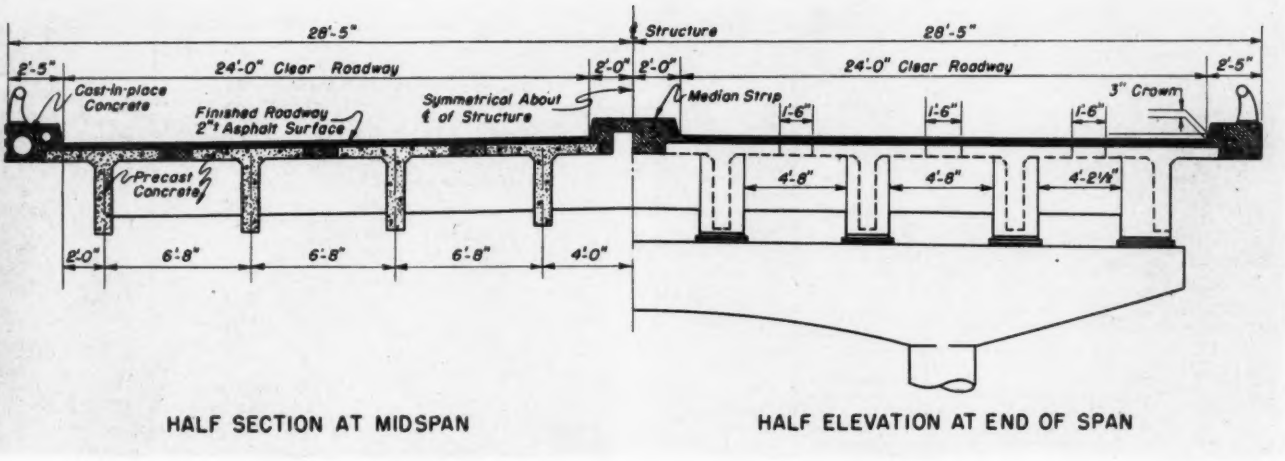
Carl L. Bankston, Jr. holds a Bachelor's degree in Civil Engineering from Vanderbilt University. He is in general charge of civil engineering work for G. A. Heft & Co., consulting engineers of New Orleans, La. His major projects include design of underpasses and overpasses in connection with the grade separation program of the city of New Orleans; structural design of aircraft hangers and related buildings at Joint Air Reserve Training Center, Bellechasse, La.; and foundation studies and reports, and design work and reports, on projects involving heavy construction for various industrial clients. He is a registered engineer in Louisiana and Mississippi and an associate member of the American Society of Civil Engineers.

WITHIN THE PAST seven years a new material of construction, prestressed concrete, has made its appearance in the United States and has gained wide acceptance in the engineering profession. While the basic theory of prestressing concrete is not at all new, and practical applications have been employed, particularly by European engineers, for about 30 years, it has been only recently that techniques of design and construction have been developed to a degree sufficient to cause American engineers to regard prestressed concrete as an honest material of construction rather than an experimental oddity. As its use becomes more general and more familiar to engineers, further improvements in these techniques can be expected, just as there have been important developments in the design of conventional reinforced concrete during the 60 years since its inception.

Although ample grounds exist for the argument that prestressing is merely a method of construction applied to concrete, it would appear that prestressed concrete has a strong claim to designation as a separate material in its own right. It should not be thought of simply as a new aspect of an old, familiar material for then the dead hand of precedent and custom might carry over into new situations.

The growing use of prestressed concrete has been due to its economy and the intrinsic advantages offered by its unique properties. However, by no means should it be accepted as axiomatic that the use of prestressed concrete always will solve a structural problem at less cost, but even when its cost is greater, other benefits accruing from prestressing may justify the payment of a premium and require the material's consideration during at least the preliminary phase of a project.

Among the advantages of prestressed concrete as compared to structural steel are its freedom from



DRAWING PROVIDES DESIGN DETAILS OF THE PRECAST AND CAST-IN-PLACE SECTIONS OF THE ROADWAY DECK.

corrosion and the need for painting, its fireproof nature, and, in most instances, its availability. Its advantages over conventional reinforced concrete are its lighter weight for identical load capacity and its freedom from shrinkage cracking and load cracking when properly designed.

The primary considerations in the design of any structure are the specifications and criteria governing that design. In the field of prestressed concrete, the engineer is almost completely unaided, or, as some might prefer, unhampered, by any recognized authority. Bridge design is an exception, for the excellent design criteria and requirements governing construction presented in the Bureau of Public Road's *Criteria for Prestressed Concrete Bridges* merit careful consideration by any bridge designer.

Types of Prestressed Concrete Members

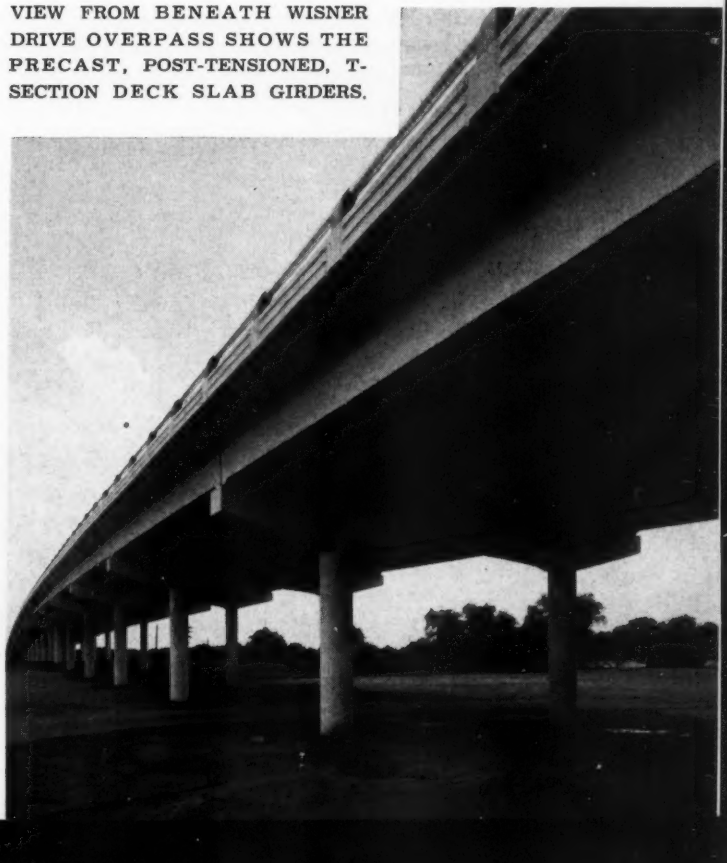
Prestressed concrete members can be divided into two broad classes: pretensioned, in which the concrete is cast around previously tensioned tendons, and post-tensioned, in which the tendons are tensioned within the hardened concrete member.

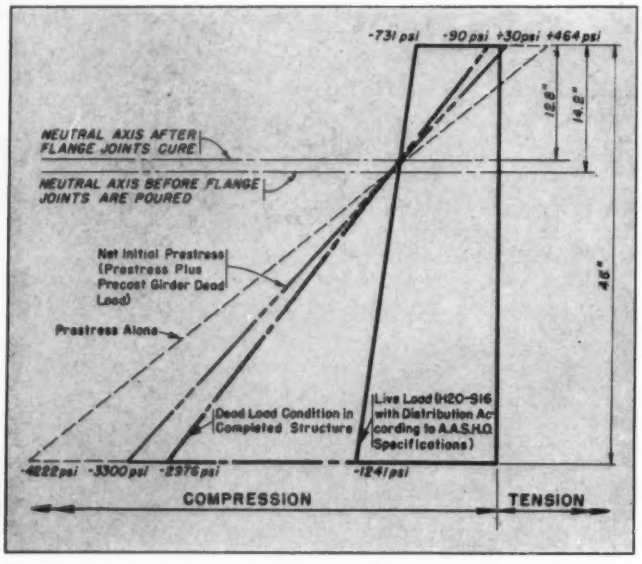
Pretensioning is necessarily a precasting operation, since sturdy abutments must be provided to react against the tension in the steel until the concrete gains sufficient strength to handle the reaction. The prestressing force usually is transmitted between the steel and concrete by bond, thus necessitating the use of small-diameter prestressing units. Tests indicate that the desired high bond strengths are better developed by small stranded cables rather than by smooth single wires of approximately the same diameter. The extensive facilities required for pretensioning operations usually demand quantity production of prestressed members.

Post-tensioned prestressed concrete may be either precast or cast-in-place as the engineer's fancy, or more likely, as economy dictates, for the concrete itself is capable of providing the necessary reaction to the steel's tensioning. The prestressing may be transferred by bond of grout, as in the large diameter, hollow cylinder piles developed by Raymond Concrete Pile Co., or by anchorages gripping the steel and bearing against the concrete. Here, the size of an individual prestressing unit is relatively unaffected except by the cost of the anchorage. An interesting variation of the post-tensioning technique is the joining of small precast units into a single member by prestressing. Ross Bryan, Nashville, Tennessee, consulting engineer, has pioneered in the use of machine-made concrete block in prestressed concrete members of this type.

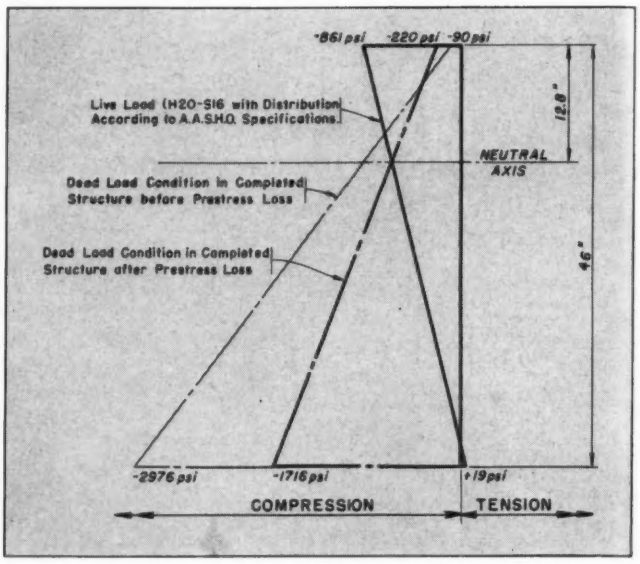
Regardless of the specific type of prestressing contemplated, the fundamental design principles remain the same. For a prestressed beam, one of these prin-

VIEW FROM BENEATH WISNER DRIVE OVERPASS SHOWS THE PRECAST, POST-TENSIONED, T-SECTION DECK SLAB GIRDERS.





MIDSPAN STRESSES BEFORE PRESTRESS LOSS FOR A TYPICAL INTERIOR GIRDER, WISNER DRIVE OVERPASS.



MIDSPAN STRESSES AFTER PRESTRESS LOSS FOR A TYPICAL INTERIOR GIRDER, WISNER DRIVE OVERPASS.

ciples is that the largest portion possible of permanent dead load should be on the beam at the time it is prestressed. In a simple beam subject to gravity loading, the centroid of prestressing steel, and thus the resultant of prestressing force, usually is located below the neutral axis of the beam (causing a bending moment opposite in sign to the moment caused by the load and exerting a compressive force along the length of the beam). The magnitude of the prestressing force and the degree of eccentricity with which it is applied are governed by the limiting safe stresses in the top and bottom fibers of the beam. The dead load moment of the beam, being opposite in sign to the prestressing moment, will cause counteracting stresses. Thus, if full dead load is applied before prestressing, the maximum amount of prestress remains in the beam to counteract live load stresses, whereas any dead load applied after prestressing reduces the stresses in the beam from their original limiting values, leaving less prestress available to counteract live load.

Initial Prestress Stresses

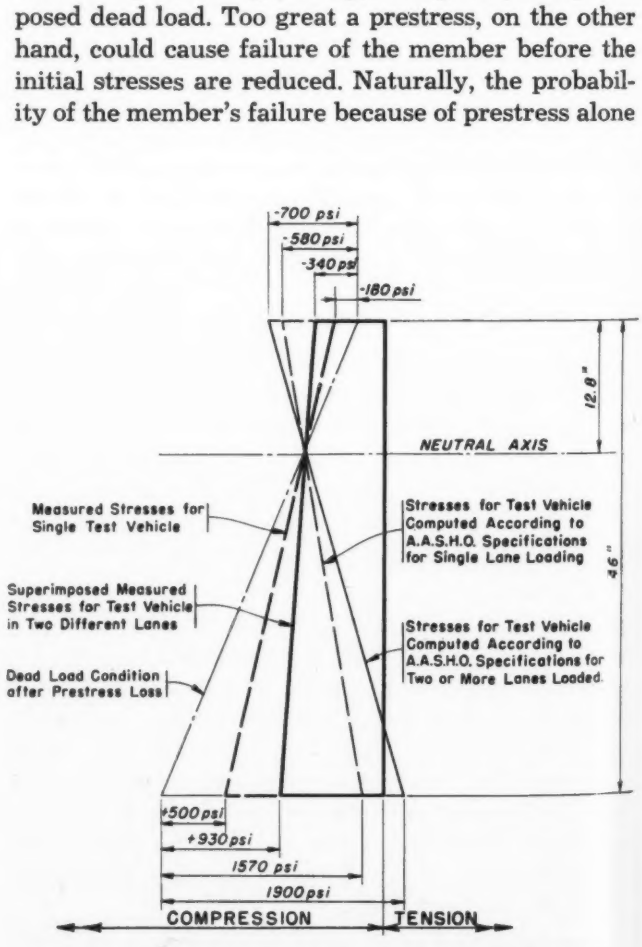
The limiting initial prestress stresses generally used are based on a lower factor of safety than the factor on which design stresses are based. The reasons for permitting the use of higher stresses are:

¶ These initial stresses become lower with time because of shrinkage of the concrete and because of creep under load of the concrete and the steel.

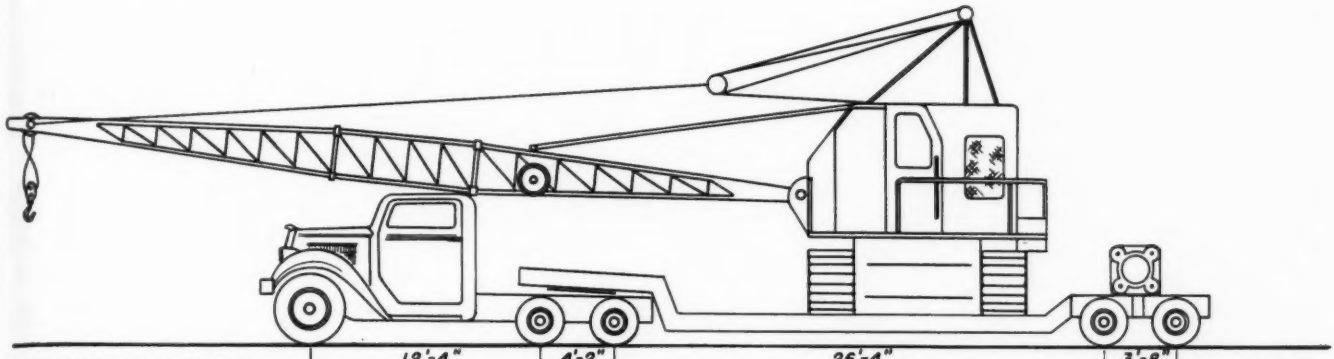
¶ These initial stresses counteract the stresses caused by subsequently applied dead load and live load thus actually reducing the stresses occurring in the loaded beam.

¶ High initial prestress stresses serve as a form of proof load to test the adequacy of the concrete and the steel used in the design of the beam.

These initial prestress stresses must be of such magnitude as to insure a satisfactory level of stress in the completed structure after reduction of the stresses by shrinkage, creep, and permanently imposed dead load. Too great a prestress, on the other hand, could cause failure of the member before the initial stresses are reduced. Naturally, the probability of the member's failure because of prestress alone



ACTUAL STRESSES MEASURED DURING LOAD TEST AND THEORETICAL STRESSES COMPUTED IN ACCORDANCE WITH A.A.S.H.O. SPECIFICATIONS, AT MIDSPAN OF A TYPICAL INTERIOR GIRDER, WISNER DRIVE OVERPASS.



ASSUMED AXLE LOADS:						TOTALS
TRUCK & TRAILER	6.8[k]	4.1[k]	4.1[k]	4.1[k]	4.1[k]	23.2[k]
CRANE	0	11.9	11.9	21.1	21.1	66.0[k]
PILE HAMMERS	0	0	0	6.0	6.0	12.0[k]
TOTALS	6.8[k]	16.0[k]	16.0[k]	31.2[k]	31.2[k]	101.2[k]

VEHICLE USED DURING THE LOAD TESTS THAT WERE CONDUCTED TO OBTAIN ACTUAL STRESS MEASUREMENTS.

will increase as the factor of safety is decreased, and even though a satisfactory safety factor may be attained subsequently in the final structure, the designer cannot afford to run the greatly undesirable risk of losing the member.

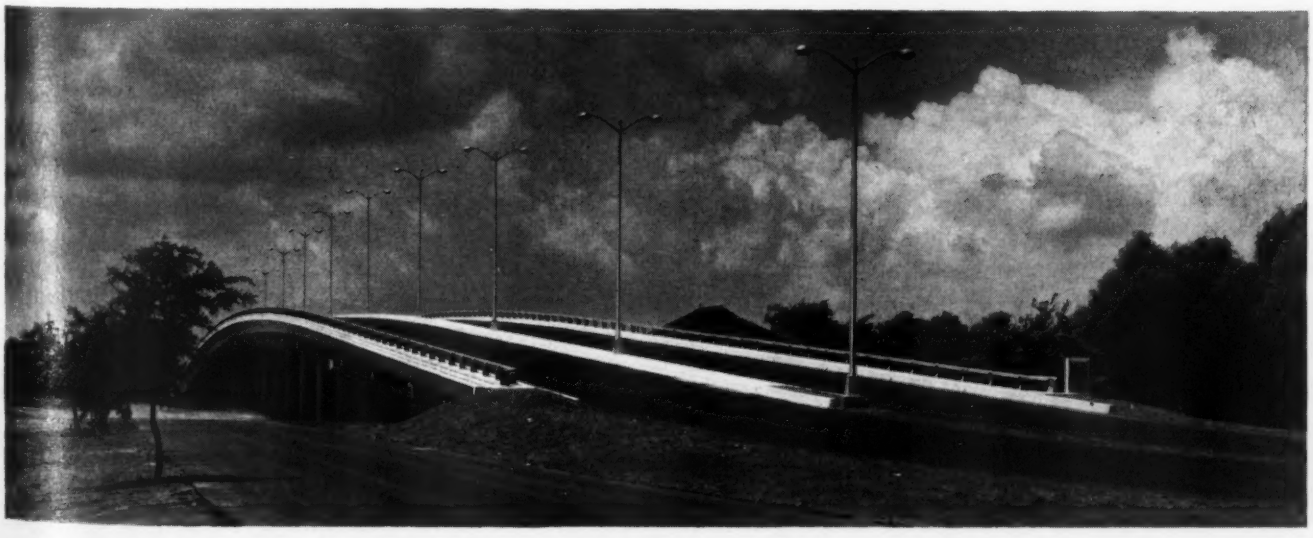
Stress Limits

The limit of compressive stress in the completed structure subjected to prestressing, dead, live, and impact loads or any combination of those loads, can be the same as for conventional reinforced concrete.

The limiting design conditions in the portions of the beam subject to tension can be established by two different methods. For the first, the limit of tensile stress in the concrete is zero. With this approach, the beam may be designed as if it were a homogeneous member composed of material capable of taking tension, since it behaves as such until the original compressive stress induced by prestressing is overcome by the tensile stress caused by loads. For the second approach, the tensile stress caused by load is permitted to overcome the prestress, and the beam is analyzed as a composite cracked section in a manner similar to analysis of a conventional reinforced concrete member under a combination of compression and bending. The tensile forces in the cracked area of the beam are taken by the prestressing steel, if it is bonded to the concrete, or by ordinary steel reinforcing. *Criteria for Prestressed Concrete Bridges* recommends using the first approach, reserving the strength of the member as a cracked section for any possible overloads.

Consideration of Loss Components

Establishing the magnitude of the loss in initial steel prestress to be allowed in design requires careful consideration for a member carrying only a little dead load after prestressing. In a situation of this type, if actual losses of stresses are less than those assumed in design, undesirably high prestress can exist in the completed member. If actual losses are greater than the assumed losses, the member may



THE STRUCTURE ITSELF — PILE FOUNDATIONS, SUBSTRUCTURE, & DECK — COST $8.52/SQUARE FOOT OF DECK AREA.

have insufficient prestress to carry its live load. A problem of this nature can best be solved by determining a minimum and a maximum value for the stress losses, determining the required size of the member using the maximum loss value, and determining the amount and eccentricity of the prestress-force from the minimum loss value. In most practical situations, however, the precision with which the magnitude of losses is determined is not too critical.

The total loss of initial steel stress is made up of four components: shrinkage of the concrete, creep shortening of the concrete, creep elongation of the steel, and elastic shortening of the concrete member as prestress is applied. The last component does not apply to post-tensioned members, since shortening of the concrete and elongation of the steel take place independently of one another as the prestressing steel is being tensioned. Because a portion of the shrinkage already has taken place in post-tensioned members before they are prestressed, their shrinkage losses also are lower than those of pretensioned members. The creep, or plastic flow, of the concrete under load, the largest component of prestress loss, takes place at a continuously decreasing rate over a period of several years. Its magnitude is dependent upon the stress in the concrete. Creep of the prestressing steel takes place more rapidly and depends upon the stress level in the steel.

Estimating Losses

A method of estimating these losses which has been fairly widely recommended is the use of a percentage reduction of the initial steel stress, usually 15 percent for post-tensioned members. However, the *Criteria for Prestressed Concrete Bridges* contains rational formulae for evaluating these losses. These give more realistic values. As an example, assume a concrete stress of 1500 psi at the centroid of prestressing steel and an initial steel stress of 175,000 psi. The formula for post-tensioned members in the *Criteria* gives a loss of 26,500 psi, or 15.1 percent of the initial steel stress. But assuming an initial steel stress of 100,000 psi, which is within the lower range of practical steel stresses, the estimated loss becomes 23,500 psi, or 23.5 percent of the initial steel stress.

These examples also point up the fact that lower initial steel stress means a greater percentage loss in the total prestressing force, and if other considerations are ignored, economy dictates the use of the highest strength steel available.

The compressive stresses caused by prestressing also serve to strengthen prestressed beams against shear failures by reducing the magnitude of the principal tensile stresses and rotating the plane upon which they act so that it is closer to the horizontal than the 45 degree plane usually considered in diagonal tension failures. The web shears also are reduced by the vertical component of the prestress force if the prestressing steel is placed so that its profile rises at the ends of the beam. This draping of the prestressing steel usually is done in post-tensioned members and also is found in pretensioned members manufactured by some yards.

Wisner Drive Overpass

The firm with which the author is associated served as consulting engineers to the New Orleans Railroad Terminal Board for the design and supervision of construction of the Wisner Drive Overpass, a recently completed, 1422-ft long, prestressed concrete structure built as part of the grade separation program of the City of New Orleans. A description of the design of the overpass structure and an exposition of the thinking behind this design will point up these general statements on the subject of prestressed concrete and illustrate their application to a specific situation.

The substructure of this overpass, although of the same high-strength concrete (28-day ultimate of 6000 psi) as the prestressed deck, is not prestressed but is constructed of conventional reinforced concrete. This substructure is one of the applications in which prestressed concrete construction appears to be uneconomical and offers no particular advantages to justify its use. These piers are composed of a cap cast monolithically with two hollow cylindrical columns, one under the centerline of each roadway. Since the columns are under compression from the load they support, no advantage could be gained here with additional compression from prestressing. The caps, which are subjected to positive and negative bending moments changing in magnitude at a rapid rate along the length, in theory would be better suited to prestressing, but the rapid change in sign of the moments creates practical difficulties.

To establish a profile for the prestressing steel that would cause moments opposite in sign to the load moments would require so much curvature in the prestressing units that friction would make them extremely difficult to tension. The curvature of the prestressing units could be reduced by appropriately varying the cross-section of the cap along its length, but this solution would mean an increase in the cost of the forms. A third possible approach would have consisted of casting the cap with a fairly uniform cross-section and placing the prestressing steel with little or no eccentricity to achieve a fairly uniform compressive prestress throughout the length of the cap. The high prestressing force needed for this approach would have required a large quantity of prestressing steel. For these reasons it seemed logical to construct the bridge's entire substructure of conventional reinforced concrete, using the high-strength mix required for prestressing in order to reduce the structure's dead load, thus paying due respect to the poor foundation conditions of the New Orleans area.

The deck of this structure is made up of eight, precast, post-tensioned girders per span — four girders

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spaced at 6 ft 8 in. under each roadway. Each precast girder is a T-section, 3-ft 10-in. deep with a flange width of 5 ft 2 in. The 1-ft 6-in. joints between girder flanges were cast in place after the girders were erected, as were the curbs and median strip.

This T-shaped girder section was selected so as to make as large a portion of the deck slab as possible an integral portion of the girder, in keeping with the idea of subjecting the member to maximum deadload at time of prestress, as well as adding the area of the slab to the cross-section of the girder at the time prestressing was applied. The section would have been slightly more efficient if a bulb or flange had been cast at the bottom of the stem, but the additional cost of forms for this more complex section would have more than offset the saving in materials.

Design Stresses

The design stresses at midspan of a typical interior girder before prestress loss are given in the following tabulation. Live load and impact stresses were computed for a section with a 6-ft 8-in. flange width, since the 1-ft 6-in. cast-in-place joints between the flanges act as an integral part of the girder by the time live loads are applied.

	Stress in psi	
	Top	Bottom
Prestress alone	+464	−4222
Dead load of girder proper	−434	+ 922
Net initial prestress	+ 30	−3300
Dead load applied to prestressed girder	−120	+ 324
Initial dead load stresses in completed structure before losses	− 90	−2976
Design live load and impact stresses (A.A.S.H.O. H20-S16)	−641	+1735
Initial total stresses before losses	−731	−1241

Steel prestress loss is estimated as 28,900 psi, or 29.9 percent of the initial steel tension of 96,500 psi placed on the alloy steel bars. After this loss of prestress is complete, stresses in the interior girders will be as follows:

	Top	Bottom
Initial dead load stresses in completed structure before losses	− 90	−2976
Change in stresses due to prestress loss	−130	+1260
Dead load stresses in completed structure after losses	−220	−1716
Design live load and impact stresses (A.A.S.H.O. H20-S16)	−641	+1735
Total stresses after losses	−861	+ 19

The low compressive stresses in the completed structure under live load result from the use of the deck slab as an integral part of the longitudinal load carrying members. The thickness of the deck slab was dictated by the requirements for carrying vehicular wheel loads on the 6-ft 8-in. span between girder centerlines. For this transverse span, the deck slab was designed as a conventional reinforced slab, since the rapid change in sign of bending moments in the slab creates the same practical difficulties in prestressing as in the pier caps. Although a slight amount of prestress was induced in the slab by the post-tensioning of the diaphragms, spaced at 15 feet in these 60-ft spans, this low compression was ignored in the slab's design.

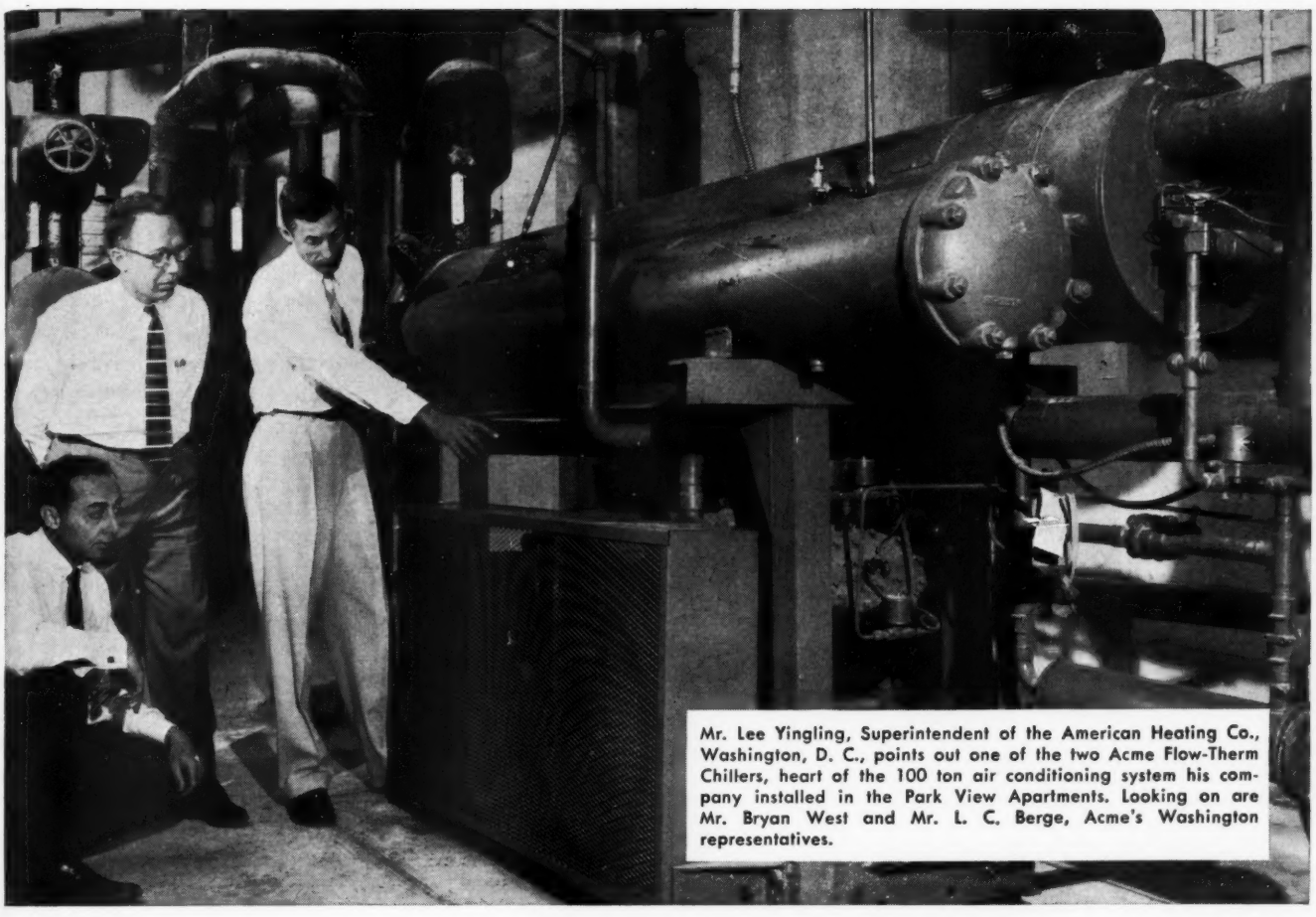
Alternate Designs

The plans for this overpass showed two designs, one for post-tensioning, the other for pretensioning. The girder section for the pretensioned design differed from the post-tensioned section only in having more mild steel web reinforcement. This additional web reinforcement was required because the straight prestressing steel units shown for the pretensioned design would have been less effective in reducing shear and principal tensile stresses in the girder than the draped units used in the post-tensioned design. As well as permitting the contractor to choose either pretensioning or post-tensioning, the specifications permitted the use of any post-tensioning system currently in use for bridge construction. The contractor elected to use alloy steel bars with a yield strength of 130,000 psi at 0.2-percent permanent set and an ultimate strength of 145,000 psi. Two, 1-in. diameter bars and six, 1⅛-in. diameter bars were used in each 60-ft girder.

An interesting comparison can be made of the estimated prestress losses for each of these optional systems allowed the contractor. As mentioned, the estimated loss for the system actually used (large diameter steel bars with an ultimate strength of 145,000 psi and an initial tension of 96,500 psi) was 29.9 percent of the initial prestress. For a post-tensioning system using wire with an ultimate strength of 250,000 psi and an initial tension of 175,000 psi, the estimated loss would have been 18.3 percent of the initial prestress. In a pretensioning system using stranded cables with an ultimate strength of 250,000 psi and an initial steel tension of 190,000 psi, reduced to 180,000 psi upon release of prestress into the concrete, the estimated loss would have been 19.8 percent of the initial concrete prestress.

Compressive Stress Values

The maximum safe compressive stress in the completed structure was established as 0.4 f'_c (ultimate compressive strength) or 2400 psi, in accordance with data listed in *Criteria for Prestressed Concrete Bridges*. Dead load alone is the loading condition causing maximum compressive stress in the girder, since live loading substantially reduces the compression at the bottom of the girder's stem while causing no great increase in compression in the flange. The minimum prestress loss required to attain the desired level of stress in the bottom fiber of the



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girder, under dead load alone, is 13.6 percent of the initial prestress. A prestress loss at least this great is certain to occur in the completed structure.

The maximum temporary compressive stress permitted by these design criteria is 0.55 f'_c, or 3300 psi, which was the net initial prestress before loss in the bottom fiber of a typical girder.

No flexural tensile stresses in the completed structure are permitted by these criteria, but a temporary tensile stress as high as 0.05 f'_c (300 psi for the 6000 psi concrete used) is allowed. For this particular structure, a tensile stress in the girder flange of 250 psi immediately after prestressing, reduced to zero in the completed structure by prestress loss and subsequently applied dead load, would have met the requirements of the criteria. To decrease the risk of damaging the precast girders in their handling and erection, and since compressive stress in the girder flange was not critical in this design, the magnitude and eccentricity of the prestressing force were established so as to cause a much lower tensile stress in the girder flange.

Arrangement of Prestressing Steel

The alloy steel prestressing bars, each encased in a flexible metal tube, ¼-in. larger than the bar, were placed in the girder forms as if they had been conventional reinforcing bars, and the concrete was poured around them. The flexible metal tubes prevented the concrete from bonding to the bars and permitted tensioning of the bars after the concrete had attained the required strength. After the bars were tensioned and anchored, a cement-sand grout the consistency of thick paint was pumped under pressure into the tube.

Pull-out tests of 1⅛-in. bars grouted into 9-in. lengths of flexible metal tubes embedded in cubes of concrete indicated that this grout mix had a 28-day ultimate bond strength of approximately 890 psi; compression tests of 2-in. cubes of the grout indicated a 28-day ultimate strength of 8800 psi. Under design live load the grout is subjected to very low bond stress, approximately 8 psi as a maximum.

A load test on this structure, performed by running a 51-ton truck over the bridge at speeds of 4 to 16 mph and measuring the resulting concrete strains and girder deflections, provided interesting data on the actual live load stresses and the behavior of the bridge's deck under live load. Distributing the wheel loads of the test vehicle and adding impact according to the provisions of the *Standard Specifications for Highway Bridges*, of the American Association of State Highway Officials, results in theoretical changes in stress of —580 psi (compression) in the girder flange and +1570 psi (tension) at the bottom of the stem. The actual changes in stress measured during the test were —180 and +500 psi.

Theoretical live load and impact stresses based on the wheel load distribution for simultaneous loading in two traffic lanes are —700 psi and +1900 psi. Stress changes determined by superimposing actual stress changes measured with the test vehicle in each of two lanes are —340 psi and +930 psi.

This comparison of the theoretical stresses with the measured stresses, and the measurement of girder deflections across the width of the bridge indicate that, in this particular structure, wheel loads are distributed transversely across the bridge deck to a much greater extent than provided by the design requirements of *Standard Specifications for Highway Bridges*. The wider distribution of load in this structure can be attributed to the action of the deck slab as an integral part of the girders as well as to the relatively closely spaced prestressed diaphragms.

Economic Comparisons

The sole reason for using prestressed concrete for this overpass was its lower cost. Although it is not possible to compare the relative construction costs of various competing materials for this project, since alternate bids for designs employing other materials were not taken, a comparison may be made between the cost of this overpass and the cost of other overpasses built in recent years in New Orleans.

The cost of the Wisner Drive Overpass structure alone (excluding approaches, lighting, and other work not an integral part of the structure) including the pile foundation, the reinforced concrete substructure, and the prestressed concrete deck, was $688,000. This figure is equivalent to a cost per square foot of bridge deck of $8.52, based on an area of 80,732 square feet, computed from the length of bridge, abutment to abutment, and the total width of the deck, including median strip and safety curbs.

The average cost per square foot of five other overpasses in New Orleans, for which bids were taken since 1950, is $10.48 per square foot, computed on the same basis. These bridges are all of steel-stringer and reinforced-concrete-deck construction. Their span lengths vary but, on the average, are comparable to the 60-ft spans of the Wisner Drive Overpass.

The average cost per square foot of the five bridges built of conventional materials is approximately 23 percent greater than the square foot cost of the Wisner Drive project. The difference in unit costs of the bridge decks alone would be even greater, since the unit costs of the substructures of the various bridges are probably about the same.

The advantages offered by the physical characteristics of prestressed concrete construction — permanency, fire resistance, water-tightness, and low maintenance requirements — plus the availability of its component materials, will prove attractive to many engineers. The advantage that will prove most attractive to their clients and that probably will increase the popularity and use of prestressed concrete is its economy, when properly employed under suitable conditions. ▲▲

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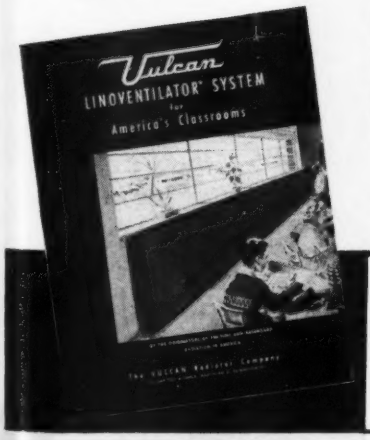

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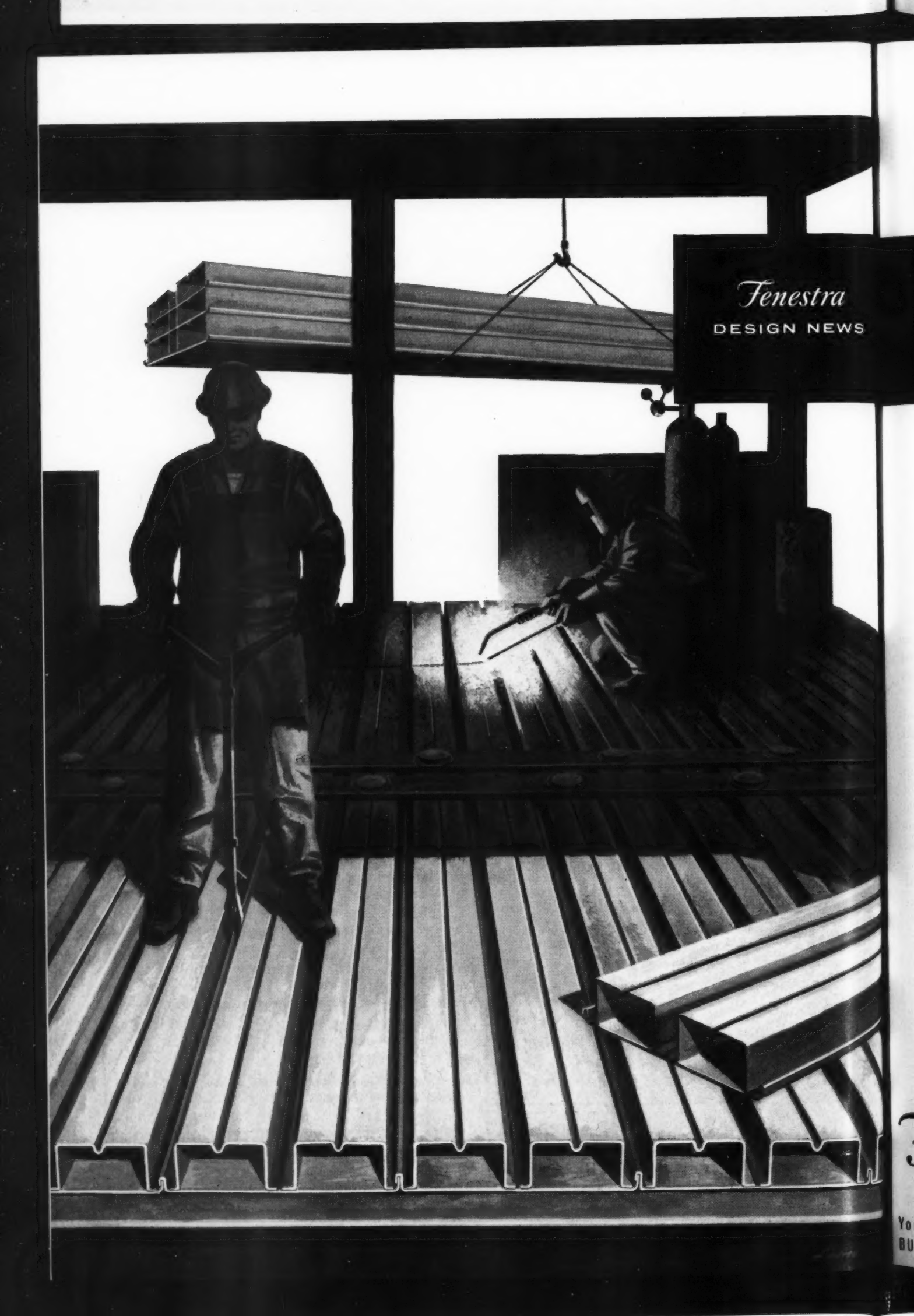
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In 1882, Parliament Passed The Electric Lighting Act...

The Law that Dimmed the Lights

DR. THOMAS P. HUGHES
Washington and Lee University

Westinghouse

WHILE ARC LIGHTS WERE BEING PUT UP IN EVEN THE SMALLER U.S. CITIES, PARLIAMENT DEBATED IN ENGLAND.

WHEN ELECTRICAL engineer George Forbes returned to England from his visit to America, in 1888, he reported to the British Association for the Advancement of Science on the remarkable advances made in American lighting during the '80's. It is unlikely that in the presence of this English, distinguished, and well-informed company he would have exaggerated American achievements, yet he recalled the remark that "there are two definitions of inertia: the English — that inertia is a resistance to motion; and the American, that it is resistance to stopping."

Forbes, who was prominent in his field and was to serve as a principal consultant for the Niagara Falls hydroelectric project, paid tribute to the English inventors who, in his opinion, had done more fundamental work in electricity than their American counterparts, but he insisted that the American moneyed classes had a greater technical awareness and exploited more fully these discoveries.

The dimly-lit streets in England were contrasted with electric lighting in the territories of the United States, where a technical paper on the introduction of electricity could be published in the same Alaskan community that needed a law for the expulsion of wild Indians from the city. Forbes found that electric lighting not only had a fixed position in such influential cities as New York, Philadelphia, and Boston, but also in the "most distant states."

America's definition of inertia and the technical knowledge of the capitalists were not the only explanations for her position of primacy — Forbes attributed slow development of electric lighting in England to "the iniquitous" Electric Lighting Act of 1882.

The "Iniquitous" Act

The Act of 1882, by which Parliament nominally intended "to facilitate and regulate the supply of Electricity for lighting and other purposes," influenced the infant English industry from the year after Thomas Edison built his famous Pearl Street station until the year Forbes made his gloomy report. The history of the "iniquitous" act is a good example of interaction of technology and politics, a subject still of serious concern to engineer and legislator alike.

The history of the Act of 1882 includes the highly significant Parliamentary investigation of 1879. The

Harpers Weekly

GAS HELD ON IN SOME CITIES. THIS RATHER FLAMBOYANT DISPLAY WAS NORMAL NIGHT LIGHTING IN FINDLEY, OHIO.

report following this investigation by a select committee describes the status of electricity in England in 1879 and the circumstances under which Parliament considered electric lighting legislation. The report also discloses the various groups and persons vitally interested in influencing — or at least in enlightening — the great legislative body which held the power to stimulate or to resist the progress of electric lighting. In addition, the report suggests the ability, or inability, of scientists and engineers to predict developments in their own fields.

Gas was the light in 1879. Burners in homes and public places consumed gas for illumination in a period of prosperity for a utility fated to live an active but short life. Gaslight was to give way to electric light in an era of dramatic engineering innovations and mushrooming public service industries.

Early Experiments

Electric light, however, when Parliament studied its potentialities, in 1879, was not without a past. Various experiments had been conducted comparing it with gas as a method of street illumination, and it actually was being used in illuminating some public places. Authorities in Paris had allowed the lighting of the Avenue de l'Opera, in 1878, with the electric candles of Russian-born Paul Jablochkoff, and the light brought an enthusiastic response. In 1879, the Metropolitan Board of Works undertook a similar test in London, and the Thames Embankment was bathed in the electric light of the Jablochkoff candle. Electric light also had replaced gas in London's spacious Royal Albert Hall, and electric lights brightened the Times building. In addition to lighting streets and other public places, electricity had been utilized for searchlights at sea, but at the time this was frowned upon and declared illegal by the Board of Trade for fear that a lighted ship would be mistaken for an electric lighthouse. These experiments and applications, however, were few compared to gas lighting.

The electric lighting used when Parliament conducted its investigation was not only in its infancy but it also varied considerably from the light that was to be used so widely in the United States of the 1880's — and eventually in England. Jablochkoff's lamps, and others attracting great attention, were carbon arc — not incandescent lights. An incandescent lamp had been invented before 1879 by Joseph Wilson Swan and in 1879 by Thomas Alva Edison, but neither the Englishman nor the American had yet proven the commercial practicability of his lamp when Parliament was hearing witnesses. Parliament was considering the future of the carbon-arc light, not the incandescent.

Electric lighting, as of 1879, also differed from lighting today in that an efficient means for dividing the energy of a generator among a number of lights had not been found, and some experts predicted that it would not be. Nor did engineers and scientists conceive of a lighting system permitting one or more

Harpers Weekly

EARLY ARC LIGHT INSTALLATONS IN THE U.S. MADE USE OF HIGH TOWERS, WIDELY SPACED. THIS IS SAVANNAH, GA.

ONE OF THE LEGISLATIVE PROBLEMS IN ENGLAND WAS, "WHO HAD THE LEGAL RIGHT TO OPEN UP THE STREETS?"

lights to be extinguished and the power consumption thereby reduced (the accepted system had the lights in series rather than "multiple arc" or parallel). The inability to "subdivide" electric light was held up to Parliament as a major obstacle to the progress of electric lighting (Edison would effectively "subdivide" on a commercial scale within 3 years).

D. C. Transmission

Another discouraging characteristic of the electric lighting considered by Parliament was the lack of a system for transmitting energy over distances greater than several thousand yards. Having no transformer for use with alternating current caused engineers and scientists to think of transmission only by direct current and through wires of considerable diameter (a diameter of 2 inches if anyone had been so bold as to attempt the transmission of electricity over a distance of 30 miles). The heavy copper wires considered necessary may help explain another peculiarity of the electric lighting system: engineers and scientists assumed all wires would be laid underground in the fashion of the gas and water pipes.

In 1879, therefore, when the committee of Parliament considered the question of legislation and the future of electric lighting, it did so on the basis of the industry as then exisiting: carbon-arc lamps; a single

lamp (or a few in series) coupled to one generator; and the transmission of energy for short distances and through large diameter wires laid under the ground or streets.

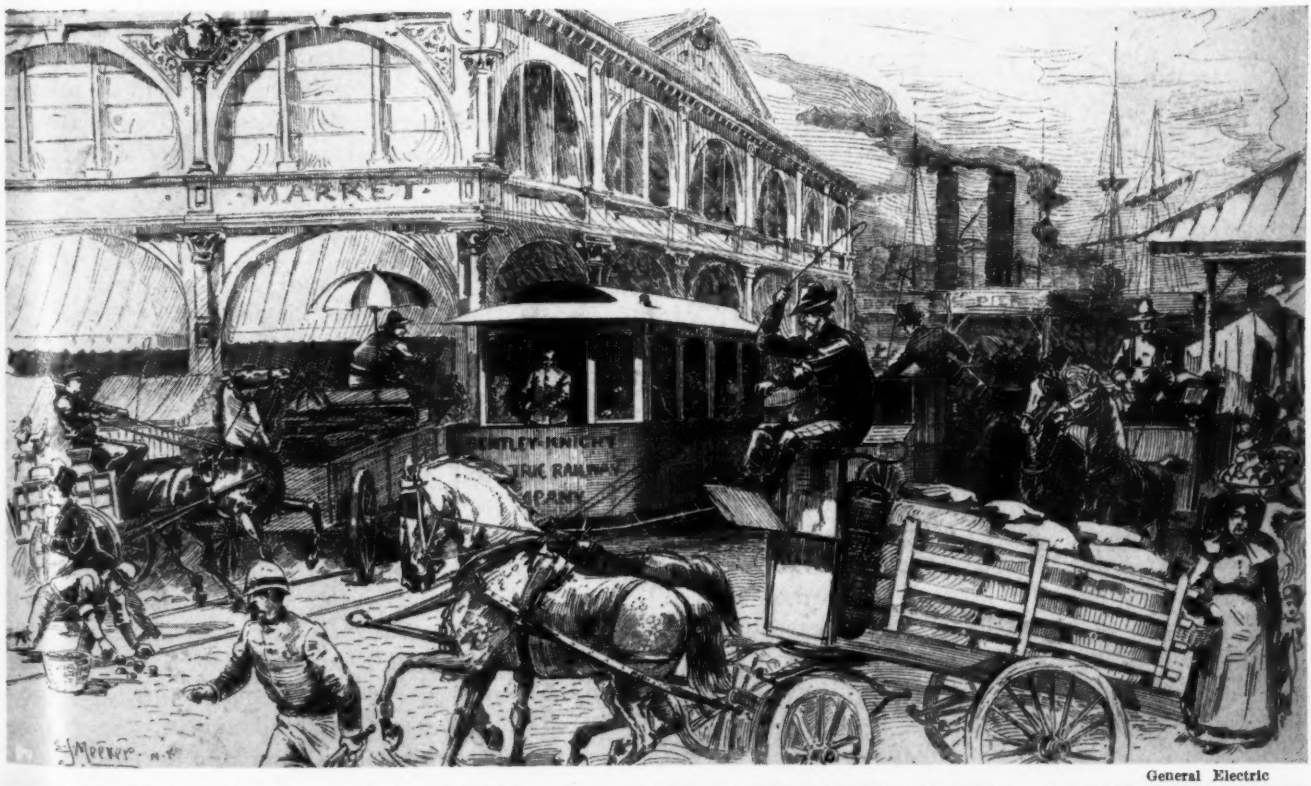
Despite the inadequacies of electric lighting and the small number of applications, the potentialities appeared considerable enough to cause a scare late in the '70's adversely affecting the position of the gas companies on the money market. In addition, the future for electric lighting appeared bright enough to cause several of the English municipalities and gas companies to apply to Parliament for power to supply public (streets, public halls, and other large areas of public utility) and private (including domestic) light. These were the immediate reasons for naming the Parliamentary committee. Head of the committee was Lyon Playfair, who enjoyed prestige both as a member of Commons and as an individual greatly interested in science and industry. He, in 1851, had been a moving spirit in organizing the first great industrial exhibition — the Crystal Palace.

The Experts

Distinguished engineers and scientists, representatives of the municipal governments, and spokesmen for the gas industry predominated in giving testimony before the committee. Among the world famous scientists who testified were Sir William Thomson (Lord Kelvin) and John Tyndall. William Siemens, brother of Ernst Werner von Siemens, perfecter of the dynamo, and an outstanding electrical engineer himself, ably represented his profession.

Lord Kelvin, who did significant work as a physicist in demonstrating the validity of the law of conservation of energy and who, as an expert on electricity, was to give advice on the best method of generating and transmitting the power of Niagara in the 1890's (advising against the "gigantic mistakes of alternating current") predicted quite correctly a large future for electric lighting. He also foresaw, in his appearance before the committee, the development of the central station. He believed, contrary to some others, that the obstacles to subdivision and transmission would be overcome. Even in 1879, however, he could not see any potential advantages for alternating current over direct, and he could only imagine lights in series, with a power-consuming resistance short-circuiting an extinguished light. He also predicted that gas engines would be used to power electric generators in private homes with a servant superintending the miniature power plant.

The testimony of John Tyndall, a physicist and successor to the great Michael Faraday, at the Royal Institution, further raises the question of the expertness of scientists in predicting the course of scientific development. Tyndall reminded the committee that there was no way of dividing between lamps energy produced by the current of a single generator without considerable loss, and predicted that incandescent lamps would not be used for public lighting as the expenditure would be far too great. Despite his pessimistic attitude with regard to the subdivided incandescent lamp, he was able to reassure committee member Earl Percy that although gaslight pro-



General Electric

ELECTRIC TRAMWAYS CAUSED AS MUCH COMMOTION IN THE LEGISLATURES AS DID LIGHTING — AND MORE ON STREETS.

duced vapors adversely affecting books and gilt picture frames — which electricity would not — that happily "our clubs" successfully removed the products of combustion.

William Siemens, the engineer — and representative in England of the German electrical equipment manufacturing firm of the Siemens brothers — emphasized the advantages of the electric light over the gaslight. He, like Lord Kelvin, foresaw the central station and, unlike Tyndall, thought subdivision presented no insuperable difficulties. But he became less expert by predicting the failure of Edison's experiments with subdivided incandescent lamps. He thought that electric light would be used for large rooms such as the drawing room and gas for smaller areas and passageways. On the other hand, he contributed to the information of the committee by insisting on the possibilities of using electrical energy for power as well as light: he called attention to the utilization, by Sir William Armstrong, at Craigside, of electricity generated from water power to light his library at night and to drive lathes and sawing machinery during the daytime.

Economic Aspects

Scientists and engineers alternately enlightened and misled the committee on the technicalities of electricity, but the representatives of the municipal governments and of the gas companies came closer to the economic and political heart of the matter. While men of science supplied the background that was supposed to help the legislator to understand electricity and to decide whether the electrical industry was of sufficient importance to require legislation, other witnesses waged a battle to decide who would benefit financially from the law when it was enacted.

The basic political and economic issues were these:

¶ Should legislation be passed permitting monopolies to exist in the field of electric lighting?

¶ If allowed to exist, would municipalities or private companies be allowed to have them?

¶ Should the gas companies be given any preference in the development of electricity?

These issues were related most immediately to public lighting, especially street lighting, as domestic lighting was thought to be further in the future. It seemed reasonable to expect, however, that the supplier of public lighting would become the supplier of domestic, just as with gas.

Englishmen then felt that history served as an excellent guide to action, judging by the testimony given before the committee. In order to reach a decision on the question of legislation and the electric light, reference was repeatedly made to the history of gaslight and to a lesser extent to the history of the tramways. Industrial and engineering history here fulfilled a utilitarian function.

Since 1847, Parliament had made laws that influenced the development of gaslight. Essentially they granted the gas companies monopolies and required that they work under certain restrictions. It had not been the intention of Parliament initially to allow monopolies but only to restrict the dividends of the companies, but when the gas companies districted municipalities among themselves on a monopolistic basis, Parliament saw the advantages of having only one company breaking open the streets. Therefore, the legislature granted the gas companies exclusive powers to break open the streets to lay mains, and acted to protect the public by limiting prices and establishing mandatory standards of quality and service. When limited price and profit stifled innovation and enterprise, the government encouraged the application of a principle allowing profit to increase when prices decreased.

Evolution of Monopoly

Municipalities had played a minor role in the development of the gas industry: one witness testified that only Liverpool had supplied itself with gas without the intervention of a privately owned gas company. On the other hand, the committee learned, an increasing number of purchases had been made by municipal governments of the plants and installations of the private companies.

The history of the gas industry revealed the nature of the evolution of monopolistic practice in the field of gas lighting and also the major role played by private enterprise in the developmental phase of the industry. Discussion of the history of the tramways disclosed a similar situation. With the tramways the municipalities enjoyed a period in which they had advantages under law for the establishment of the public utility. Since the passage of the Tramways Act of 1870, however, only a disappointingly small number of municipal governments or local authorities had taken advantage of the opportunity. Private companies, by contrast, frequently applied to Parliament for the power to operate tramways when the municipalities failed to do so.

Gas Group Testimony

Witnesses arguing for the interest of the private gas companies emphasized the sluggishness of public ownership. Not only did gas companies oppose any legislation that would have given the slow-moving municipalities a monopoly in the electric-lighting field, but they also took a stand against any legislation that would encourage the development of electricity, privately or publicly owned, at the expense of gas. An engineer for a London gas company warned that electric light systems would not allow for easy expansion to serve additional customers and could not meet the sudden demands imposed by London fogs. This witness offered a number of unsubstantial technical reasons allegedly demonstrating the impracticality of electricity, and this brought the reminder that the oil light interests had leveled similar

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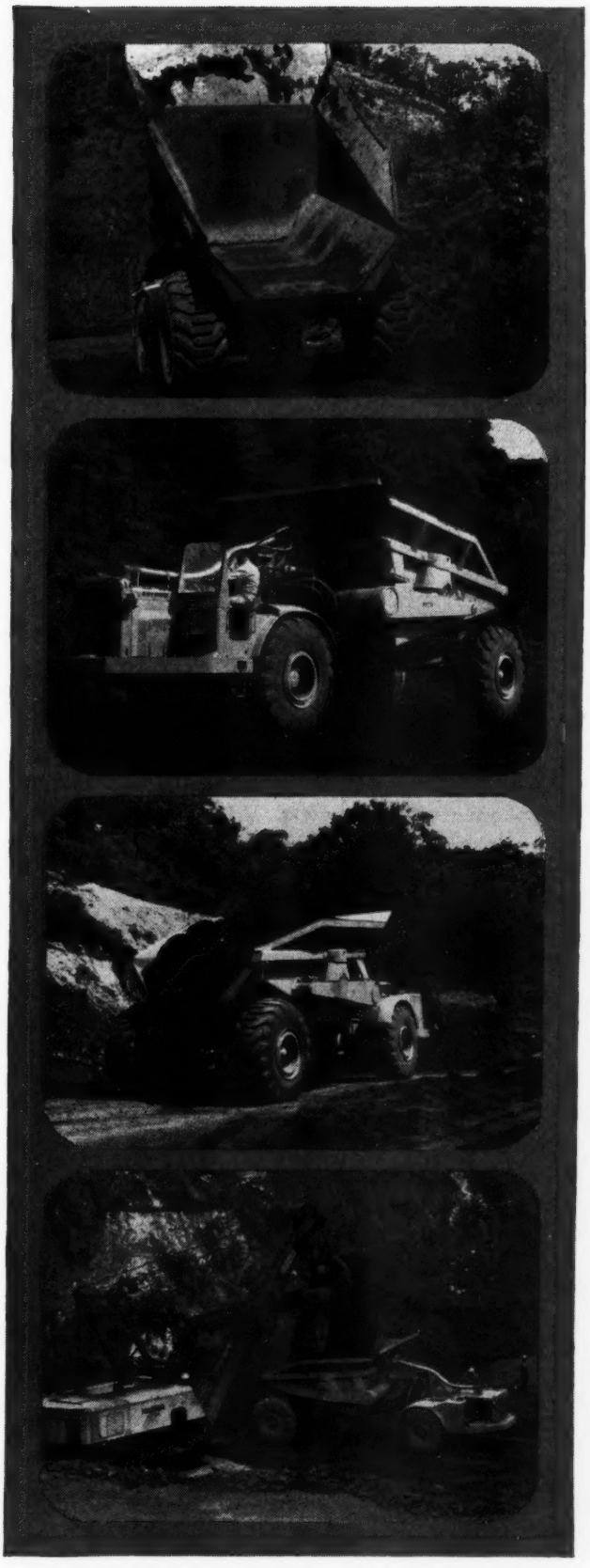

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attacks against the infant gas industry. The engineer would admit no such historical recollections.

Witnesses for the private gas companies also maintained that Parliament should protect the investments of the numerous persons participating in the ownership of the gas companies. The reluctance of the gas company to experiment with electricity was defended by the contention that the cost would be unjustly borne by the customer.

Other testimony given supported both the privately owned gas company in particular and private enterprise in general. One witness contended that the British Parliament had stood and should stand opposed to the use of public money in competition with private, and in a more compromising vein the position was taken that a privately owned company should never be prevented from taking action or supplying a service that a municipality would not. Another significant argument suggested that public money should be used for public purposes (street lighting) and private money for a commercial venture (domestic lighting).

The Cities' Arguments

When the representatives of the municipalities presented their position, they emphasized the question of opening the streets, the essence of the gas monopoly in the past and a right expected to be the essence of an electric light monopoly in the future. Knowing that the gas monopoly basically consisted of the power to break open the streets and expecting the heavy electric wires envisaged by the scientists and engineers to be laid beneath the streets, a leading spokesman for the municipalities claimed that control over the public street rightly lay with them.

Having heard fact and opinion from scientists and engineers, representatives of the gas companies, and spokesmen for the municipalities, the committee had at hand the information and opinion necessary to reach its decision, for the electric companies were not yet numerous or strong enough to play a vital role.

Chairman Playfair and his colleagues made a report to Parliament that favored the municipalities for both public and private electric lighting. The committee decided that the municipalities should enjoy the power to break open the streets to supply public electric light, and that when the distribution of light for domestic use became feasible the municipalities should have the first opportunity to develop distribution. Only after the municipality had failed to develop domestic electric light should private companies be given restricted monopolies in the form of power to break open the streets. Also favorable to the municipalities was the suggestion that they have a reversionary right to purchase the plant of private companies after a limited number of years. The report recommended no immediate legislation, since municipalities already had control of their streets.

Three years later, after Thomas Edison had designed central power stations both in England and in the United States, Parliament enacted legislation to govern the young industry. Another committee held an investigation and made a report before the Electric Lighting Act of 1882 reached its final form.

As enacted — and in the spirit of the report of 1879 — the legislation gave the municipal governments (or local authorities) a most favorable position. Not only would the municipalities have to give consent when an individual or company (or in theory the municipality) applied to the central government (Board of Trade) for a license to supply electricity, private or public, within the jurisdiction of the municipalities, but the municipalities also would have the power to give or withhold consent when the license came up for renewal every five years. By this provision the municipality could give itself or a private company a monopoly.

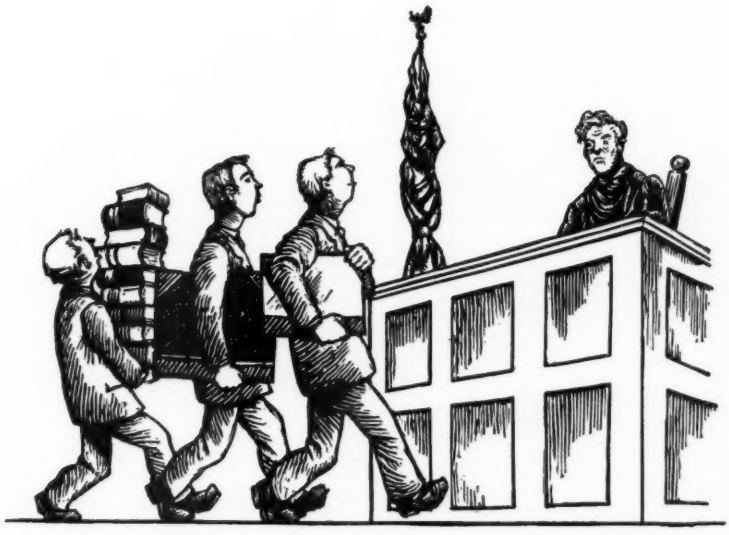
It was possible for the party or person wanting to undertake the supplying of electric light to do so without the license and consent of the municipality by obtaining a special act of Parliament, but again under the condition that the municipality could, after a limited number of years, have the right to purchase that part of the undertaking which came within its jurisdiction.

By 1888, when George Forbes labeled this law iniquitous, it had become clear to many persons that private capital had not shown a pronounced willingness to take the risk inherent in promoting an electrical enterprise under the conditions imposed by the Act of 1882. With a license that had to be renewed every few years, the future remained uncertain and, faced with a forced sale, "upon terms of paying the then value (exclusive of any allowance for past or future profits . . .)," private enterprise had reason not to risk its capital.

What were the Reasons?

In conclusion, the question arises as to why Parliament should have followed a course of action detrimental to the progress of the electric lighting industry, a policy that held England many years back of the United States in that field. On the level of immediate cause, there is the possibility that Parliament was sympathetic to the vested gas interest — with justifiable reason — rather than to an infant enterprise. England had completed its industrial revolution and was less aggressive in encouraging new industry when compared to such nations as the United States, which was experiencing a period of extensive industrial change and growth.

On the level of underlying cause there is the increased popularity in the last decades of the 1800's of socializing legislation in Europe and especially in the area of municipal government. The president of the Board of Trade at the time of the Act's passage was Joseph Chamberlain who had won fame for the socializing of utilities as mayor of Birmingham. ▲▲



Engineers Should Know Why . . .

We Oppose Corporate Practice

JAMES P. O'DONNELL, Consulting Engineer

James P. O'Donnell is a graduate engineer with B. S. and M. S. degrees, registered in New York State since 1935 and also in six other states. He has been a consulting engineer since 1945, and now maintains offices in New York City and Beaumont, Texas. Long interested in the ethical aspects of engineering practice, O'Donnell is a member of the New York State Association of Consulting Engineers; a member and director of the Association of Consulting Chemists and Chemical Engineers; and a member of the New York State Society of Professional Engineers. His activities with NYSSPE include: member of the State ethical practices and State legislative committees; chairman of New York Chapter ethical practices committee; and representative of the State Society on the joint professional committee for study of the education law (registration law).

IT HAS BEEN ARGUED that much of the controversy concerning corporate or noncorporate practice of engineering is based on misunderstanding.[1] This is undoubtedly true, as much of the evidence offered by advocates of corporate public practice actually has nothing to do with public practice. They stress financial, tax, and management problems prominent in contracting and manufacturing corporations whose normal engineering activities are not in the public practice area of the profession. Fundamental to any discussion of the problem is an understanding of the two broad classifications of professional practice in engineering, public practice and nonpublic practice.

Two Practice Areas

The distinction between the two practice areas is based on principles underlying the Model Law which was drafted by engineering societies to be used as a guide for state legislatures in setting up registration laws.[2]

¶ In public practice, professional engineers offer professional services directly to the public or are engaged as state or other governmental agency employees on public projects, and they assume the final responsibility.

¶ In nonpublic practice, engineering is one of several elements in the final product of an enterprise, and the responsibility lies with the organization as a whole. In this class are engineers (research, design, planning, or construction) in the employ of manufacturers, utilities, and educational institutions. Here engineering is the means to an end. The final decisions and responsibility lie with those legally responsible corporations and are exercised by their executives.

As no definitions of this nature can be precise,

there are some professional activities in engineering, as in other professions, that are not readily classified as public or nonpublic. Most engineers probably engage in both practice areas at various times during their professional careers; consulting public practice generally following in later professional life. The term "practice," without further qualification, usually refers to the public practice area of a profession.

The Professional Concept

It is inherent in the practice of the learned professions that the rendering of service to the public must be based on the competence and integrity of the professional practitioner. Individual responsibility must be assumed by him, and in order to do so it is axiomatic that he must fully and independently control his practice. These characteristics of a learned profession cannot be complied with through a corporation, a principal feature of which is the avoidance of individual responsibility. Chief Justice Marshal once defined the corporation as "An artificial being, invisible, intangible, and existing only in contemplation of the law." Legislative, judicial, and professional actions have endorsed the professional concept.

Legislative Actions

Most registration laws were enacted in the period when the legally recognized engineering profession was developing. There was little awareness of its public responsibilities for safeguarding life, health, and property, and most early laws therefore included express provisions permitting corporate public practice. In Senator McCawley's article[1] he made the comment that most registration law provisions purporting to authorize corporate practice appear to have been inserted for no other purpose than to effect the passage of the Bill.

However, the majority of modern registration laws, initially enacted in the last 20 years, (including all of the last eight) omit such provisions. Missouri, in 1941, was the last exception to this modern legislative trend.

Judicial Actions

The New York Court of Appeals has held that corporate practice of learned professions is obnoxious:

"The legislature in authorizing the formation of corporations to carry on 'any lawful business' did not intend to include the work of the learned professions . . . which for time out of mind have been given exclusive rights and subjected to peculiar responsibilities."[3]

This Court of Appeals decision also prohibited indirect practice through a corporation employing competent professionals to practice for it "as that would be an evasion which the law will not tolerate. *Quando aliquid prohibitur ex directo, prohibitur et per obliquium.*"[3]

This case referred to practice of the legal profession, but the same principle is involved and should be recognized in legislation pertaining to the public practice of all learned professions.

Although two recent laws enacted by the U. S. Congress, District of Columbia, in 1951, and Canal Zone, in 1956, are wholly silent on corporations, the silence in the District of Columbia Law has already been interpreted by a United States District Court as prohibiting the registration of corporations to practice professional engineering. The decision was appealed but has been upheld by the United States Court of Appeals. The words of the Court in this decision bear repetition:

"Obviously a corporation cannot take an examination. It is clear to the Court that the statute must be construed by its very terms as inapplicable to corporations and applicable to natural persons only.

"It may be added that traditionally only natural persons may practice a learned profession, because only natural persons can be charged with the moral responsibility that practice of a learned profession requires. While traditionally the learned professions have been regarded as the law, medicine, and the ministry, I think that engineering, too, may properly be included in that class."[4]

Professional Actions

In one of the few opportunities presented to individual engineers to go on record, the registered engineer members of the New York State Society of Professional Engineers strongly endorsed the professional concept. In 1953, in the midst of active controversy over the corporation problem, they adopted, by a statewide vote, two significant Amendments to the constitution of their Society:

The word "natural" was inserted in this stated purpose of the Society—

"—to safeguard life, health, and property by restricting the practice of engineering to properly qualified 'natural' persons;—"

The duty of Society officers and directors was made explicit in the vital matter of assisting in the enforcement of the law. This Amendment was adopted overwhelmingly in the midst of the concerted efforts of corporate public practice advocates to weaken the law.

"It shall be a primary and continuing duty of the officers and directors of this Society to cause

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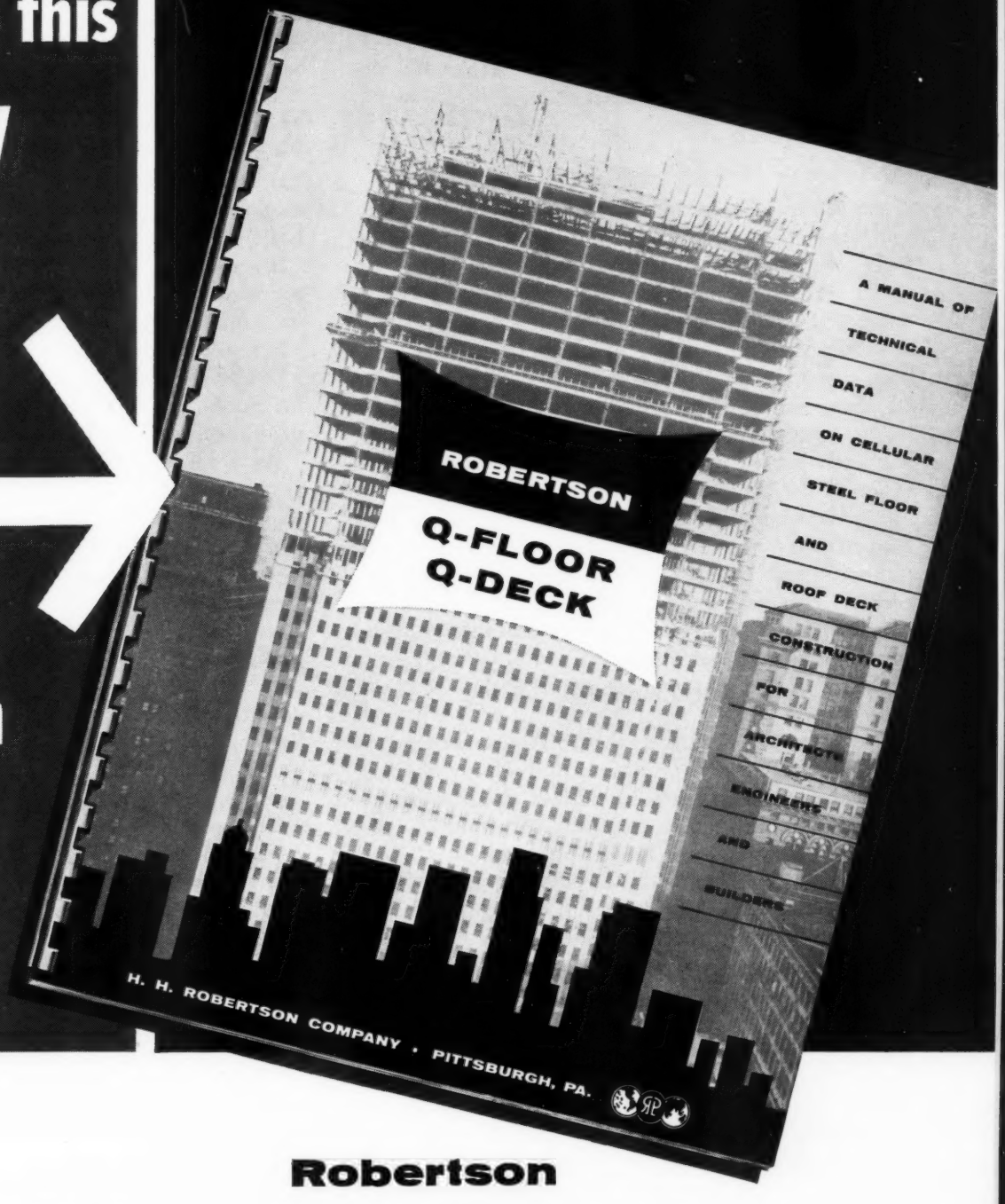
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to be instituted and assist in legal action against violators of the Engineering Licensing and/or Registration Laws and Practice Acts of the State of New York."

The Corporate "Problem"

Advocates of corporate public practice have concentrated their recent efforts in New York State. Four unsuccessful attempts have been made to obtain permissive authority for corporations to re-enter the public practice area of the profession. It is essential to an understanding of the problem to keep these facts in mind:

¶ For the past 35 years the extensive area of non-public engineering carried on within corporations has been lawful in New York State under a provision of the Education Law enacted in 1921.[5] Most registered engineers probably are employed in this area and are not directly involved in the corporation problem. As citizens, however, they are concerned with any police power law of their State whose purpose is to safeguard life, health, and property, and as engineers they are concerned with any problem that might endanger the status of their profession.

¶ For over 20 years, since a 1935 Amendment, corporations have been prohibited only from offering services in the relatively small area of public practice.[6] It is to be noted that the 1935 Amendment was sponsored by the New York State Society of Professional Engineers, and had the support of the State Education Department and legal and executive officials of the State. Immediately after its enactment it received strong endorsement in both news and editorial comment of the nationally circulated *Engineering News Record*, of April 25, 1935. This publication recommended that the step should be followed by all states and lauded its requirement of "personal responsibility" in engineering.

¶ For almost 20 years there appears to have been no complaint of any inequity in this professional law. Suddenly, in 1953, a group of corporations began a concerted effort to nullify the 1935 Amendment and permit the return of corporations into the public practice area.

This first corporate Bill was presented by representatives of eight corporations at the Friday session of the 1953 meeting of the New York State Society of Professional Engineers. These representatives said it would be introduced in the State Legislature three days later, on Monday, Feb. 9th.

How the Problem Arose

It is most important to note that this problem arose through a Bill sponsored not by a professional society, by the State Education Department, nor by a public group demanding stricter regulation to carry out the law's purpose—to safeguard life, health, and property. Instead, it was sponsored by a group of business (stock) corporations, primarily engaged in construction or manufacturing.

The State Society membership voted emphatically to take all possible steps to defeat the Corporate Practice Bill on the grounds that:

¶ It would lead to results dangerous to the "safeguarding of life, health, and property" which is the basic premise of the engineering law.

¶ It would undermine the practice of our learned profession which, as in medicine and law, is based on individual competence and responsibility.

¶ It would encroach on the architectural profession.

¶ Enforcement of disciplinary provisions of the law for public protection would be tremendously difficult, if not impossible, and very expensive.

As a result of strong opposition on the part of registered engineers throughout the State as well as members of the other learned professions, the Corporation Bill was never enacted.

The original group which had sponsored the Bill then enlarged its numbers and set up an organization which it called "The Committee on Engineering Laws" (CEL). Its objectives are described in its own literature as primarily to promote the right of corporations to engage, anywhere in the United States, in the practice of engineering under reasonable conditions and safeguards designed to protect the life, health, and property of the public.

Three other Bills were sponsored by CEL in 1954, 1955, and 1956; all failed to be enacted. In all these years there is no record of a single instance where a professional or technical society in any engineering field has endorsed a CEL sponsored Bill. On the contrary, there are many who have voiced their opposition.*

Professional Partnership

There is firm basis for restricting the public practice of learned professions to professional partnerships (all partners registered) or to registered individuals. The maximum safeguarding of human rights—life and health, and of property rights is thus assured because:

¶ Ultimate control, which is ownership, of the practicing firm is fully professional.

¶ Working management control at top levels of the practicing firm is also fully professional, as the registered partners are the managers.

¶ Liability to the public is placed on the owner principals. There is no corporate "veil" to limit their liability or cloak their identity.

¶ As the professional principal fully controls his

* The New York State Society of Professional Engineers, The New York State Association of Architects, The New York Association of Consulting Engineers, The American Institute of Consulting Engineers, The American Society of Civil Engineers, Metropolitan Section, The Medical Society of the State of New York, The Dental Society of the State of New York, The New York State Society of Certified Public Accountants, and many civic and trade organizations.

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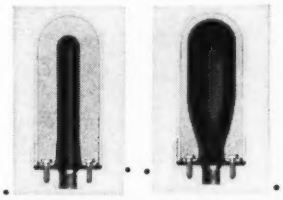

ABSORBO tube and insert shown in normal position, before faucet or valve is opened.

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practice, his personal integrity directly influences critical decisions involving the public interest—life, health, or property rights.

¶ A confidential relationship between the client and the practitioner can be readily maintained. While there is much emphasis on this in law and medicine, in engineering it is also important; particularly where patentable disclosures are made by clients or where other confidences are involved as in engineering consultation on chemical processing, mining, or oil exploration.

Arguments and Answers

Those favoring corporate practice claim that corporate practice is necessary because engineering is too complex; heavy financing is required; projects are too large; operations are too extensive.

Actually, the cost of the public practice of engineering is a small fraction of total project costs. Such practice on large projects has been handled almost exclusively by firms in partnership or individual practice. A current example is the $100 million Mackinac Straits Bridge in Michigan engineered by the New York firm of D. B. Steinman. Another current example is the recent completion of the New York State Thruway, costing approximately $500 million, on which the engineering was handled by a group of partnerships and individual practitioners, all qualified under the present New York Law.

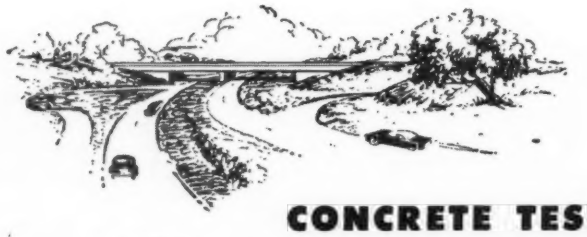
Also in the nuclear and atomic fields much of the financing is Government sponsored, Government aided, or Government guaranteed. Partnership engineering firms have and can work together as teams on large projects. Groups of professional firms can be even more effective in such joint ventures than corporations.

Proponents of corporate practice in New York also argue that the grandfather corporation privilege[6] discriminates in favor of a few corporations.

Actually, such grandfather exemptions are common in professional laws; for example, New York's architectural and dental statutes. They are based on accepted standards of fair play under which the operations of statutes are normally made prospective only and not retroactive.

The privilege is strictly controlled and can be irrevocably lost if a corporation does not continuously employ a New York registered engineer as its chief executive officer and show such a lawful continuity in its practice dating back to at least 1935.

Corporations practicing today under the grandfather privilege have a great stake in maintaining a high standard of practice because their dissolution for malpractice, or for any other reason, would be



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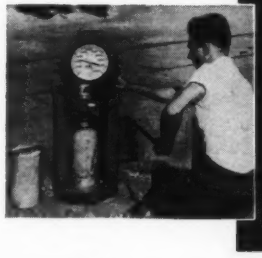

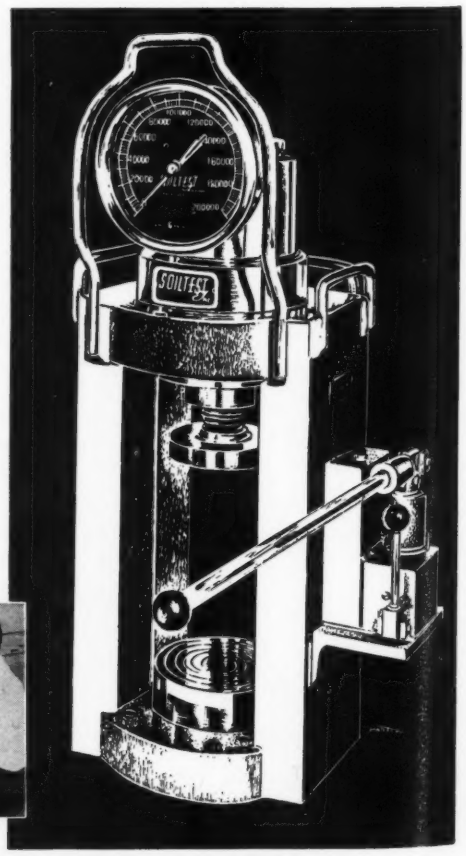

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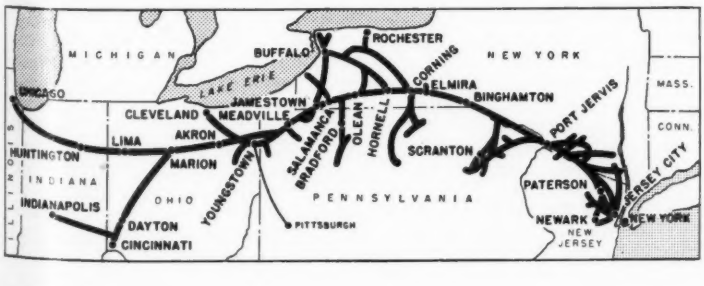

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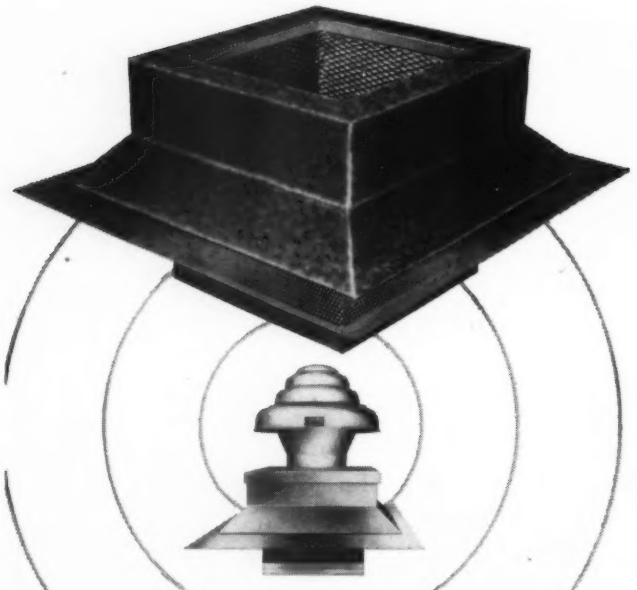

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final. Principals could not re-enter practice under another corporate name. By contrast it is to be noted that under any new legislation permitting corporate public practice, a similar dissolution required because of malpractice, or any other reason, would not prevent the principals from re-entering professional practice through the easy stratagem of forming a new corporation under the Corporate Practice Act. It is also to be noted in this connection that none of the recent proposed legislation requires that all principals (stockholders, directors) be registered engineers as present law requires for professional partnership practice. Therefore, the nonengineer corporate principals could not be subjected to any penalties provided for professional malpractice because these penalties are applicable only to registered engineers.

It is well recognized that we are entering a period of increasing public hazards connected with engineering projects, especially in the atomic energy and chemical process fields. To reduce or in any way weaken the laws enacted to safeguard life, health, and property, could result in disaster. Rather than weaken such laws, the profession and the legislatures should bend every effort to secure maximum safeguards for the public. ▲▲

References

1. "The Corporate Practice of Engineering," A. L. McCawley, CONSULTING ENGINEER, May 1956.

2. "Principles Underlying the Model Law," AIEE, Nov. 1937.

3. Re Co-operative Law Co., 198 N.Y. 479.

4. Potomac Engineers v. Daniel Walser etal, U.S. District Court, District of Columbia, 127 F.S. 41, 42, Dec. 22, 1954. Affirmed on Appeal 96 vs App. DC 64, 223 F 2d 356, June 9, 1955.

5. Article 145 Education Law Section 7209-1:
"— Nothing in this Article shall be construed to apply to the preparation or execution of designs, drawings, plans, or specifications for the construction or installation of machinery, or apparatus constructed or installed by the corporation, partnership, or joint stock association preparing such designs, drawings, plans, or specifications if the supervision of the preparation of any such designs, drawings, plans, or specifications, construction or installation shall be under the general direction of a licensed engineer, and nothing in this Article shall be construed as prohibiting licensed professional engineers from making land surveys where such surveys are essential to engineering projects."

6. Article 145 Education Law Section 7209-1: (Grandfather Corporation Exemption; New York State).
"1. — Nothing herein shall apply to a corporation, partnership, or joint stock association, organized and existing under the laws of the State of New York which on the fifteenth day of April, Nineteen Hundred Thirty-Five, and continuously thereafter, was lawfully practicing professional engineering or land surveying in New York State, and then only provided that the Chief Executive Officer, if a corporation, and each member if a firm, copartnership, or joint stock association, shall be a licensed professional engineer if practicing professional engineering or a licensed land surveyor if practicing land surveying, and provided further that the person or persons carrying on the actual practice of engineering or surveying on behalf of, or designated as 'engineer' or 'surveyor,' with or without qualifying or characterizing word, by such corporations, partnerships, or joint stock associations, shall be authorized to practice professional engineering or land surveying as provided in this Article. —"

Report from Russia

A. J. STEIGER
Special to
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Россйя

RECENT STUDIES of Soviet Professional Manpower conducted by the National Science Foundation have awakened wide public interest in the current status of the engineering profession in the USSR. The studies have shown that while the USSR, in 1953, had roughly 2 million persons with the equivalent of a college degree as compared to about 53 million in the U. S., the number of Soviet professionals in such applied scientific fields as engineering, agriculture, and medicine was about equal to or somewhat above the number of persons engaged in these occupations here.

CE exclusive

"In 1953, the Soviet Union had about 500,000 trained professional engineers, while in the United States there were about 530,000 trained engineers," the National Science Foundation report stated, adding, "the Soviet Union had about 280,000 physicians (and only 20,000 dentists) while in the United States there were about 195,000 physicians (and about 90,000 dentists). The U. S. had about 150,000 trained agricultural specialists while USSR had 170,000 . . . There were (however) less than 100,000 professionals in the USSR with training in the socioeconomic sciences as compared with over a million in the U. S."

The figures make clear the importance attached to the engineering profession in the Soviet system. These figures also make clear that it is precisely in the technological and engineering field—the realm in which modern society has been advancing at the fastest pace toward the atomic age—that the USSR presents a growing manpower challenge to American science and industry.

In this situation, it is not without interest to know how Russian engineers function in the Soviet system, within what frames of reference they operate, and how they are mobilized to carry out engineering assignments both at home and abroad.

Working Set-Up

The set-up that the engineering profession confronts in the USSR is an outgrowth of the Soviet system of industrial management of state-owned enterprises. The private engineer, or engineering firm, is not to be found. All engineers are employees of the state and are enlisted on the payroll of one or another ministry. The profession is "industry-centered," being employed in this or that specific industry under state direction. The professional scope runs the gamet for the whole of modern industry from making nails to designing an atomic energy plant.

The Russian engineering profession thus has its basis of organization in the structure of Soviet industry. This structure is clear from a mere listing of the principal industrial ministries of the government. These ministries which control the operation of nation-wide industries on a national administrative basis are:

Iron and steel	Shipbuilding
Petroleum	Automobiles
Coal	Machine tools
Power	Instruments
Nonferrous metals	Electrical machinery
Chemicals	Agricultural machinery
Rubber	Heavy machinery
Pulp and paper	Transport machinery
Munitions	Construction machinery

There are, in addition, ministries that control nation-wide industries on a republican administrative basis. For example, each of the 16 republics making up the USSR has its own republican ministry in these industries:

Textiles	Consumer goods
Timber industry	Building materials
Fish	Meat and dairy products
	Other foods

Each ministry has its own corps of engineering specialists, and the number of engineers employed in each ministry has been rising steadily over the past quarter century. A recent report on specialist

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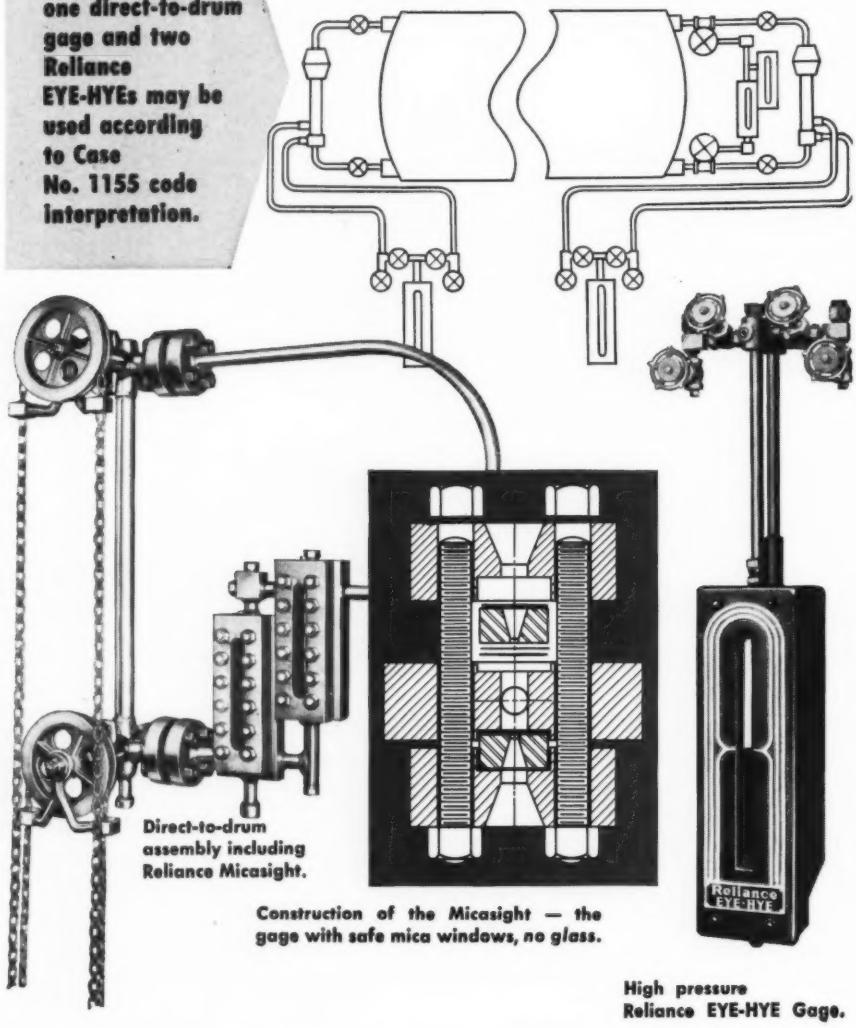

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training in the textile industry shows that, in 1924, more than 30 years ago, the Russian republic's textile industry employed 181 engineer specialists, of whom 155 were in cotton cloth, 15 in woolens, 9 in linen, and 2 in silk. At present there are over 16,000 engineer specialists with higher education in the Soviet textile industry, and it is planned to train an additional 11,000 by 1960. In the whole of Russian industry in 1917 there was not one research and training institute for textiles; now the textile industry in the USSR has 5 such institutions and 25 textile technical colleges with 25,500 enrolled students.

The growth in the number of industry-trained engineer specialists has been similar, perhaps even more spectacular in the heavy industries such as iron, steel, oil, and machinery, since these are given priority rating over consumers' goods in the program that has been set up for national economic development.

Channels of Operation

The Russian engineer functions within the framework of Soviet industrial management, in which a significant part is assigned to the Technical Department and the Capital Construction Department in each ministry. These two key departments—from an engineering viewpoint—are found in every industrial ministry and carry out operating and construction projects, which the ministry conducts under the state economic program.

The Technical Department promotes technical progress in its branch of industry; studies and keeps track of production capacities; introduces new machines and processes; and examines and passes on suggestions for changes in technological methods. Their function might be compared to function of plant engineers employed by industry in the U. S.

Capital Construction

The Capital Construction Department draws up the plans for capital development for the industry as a whole, supervises their fulfillment, and examines and passes on the building plans and estimates. They do the work

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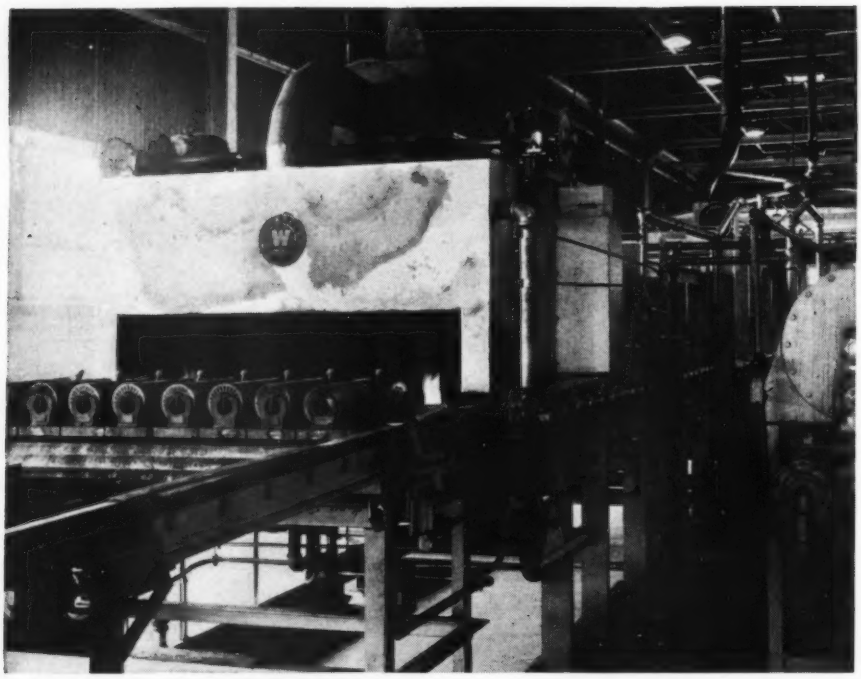

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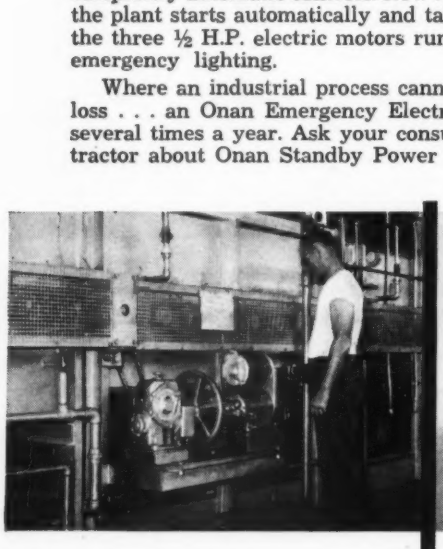
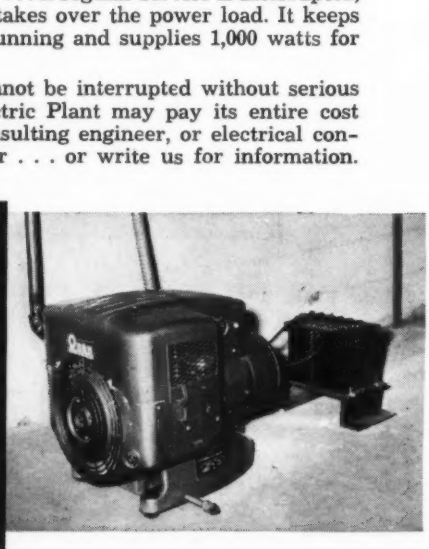


This is one of the electric motors on the emergency power circuit. Power is transmitted through the gear reducer in the foreground to drive furnace rollers at very low speed.



The Onan 3,500-watt emergency plant is installed in the plant 300 feet from the furnace. Automatic start and stop control is located near the furnace.

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done in this country by consulting engineers.

The ministry structure usually is duplicated throughout the industry, so that every industrial plant it administers has its own technical and capital construction departments operating under the direction of the office headquarters. The corps of engineers attached to these departments, whether at the ministerial or the shop level, exercise unified control of engineering work being done in the ministry, and consultation is carried out within the ministry's management.

Consultation

The function of consulting on engineering projects, which is a private enterprise in western countries, is done on a collective basis in the system of Soviet industrial management. There are several ways in which technical consultations are carried on, varying with the level of administration involved.

Top-level consultation goes on in the State Planning Commission, an agency of the Council of Ministers which exercises national supervision of all ministers, including the industrial ones. This commission formulates the national program of economic development which, after adoption by the Government, becomes a law, and all industrial establishments are compelled to operate within it. The plan fixes the output program for each industrial ministry in considerable detail, down to the level of plant output —even to the number of engineers and technicians that will have to be trained to make the plan a success. A vast amount of inter-industry and inter-department consultation goes on in drawing up the national plan, which is formulated on a general five-year basis and which is under constant study. All industries get into the act, and if the program for one industry is revised, many others are affected. A request for increase in the output of cotton fabrics, for instance, involves digging new irrigation canals to expand cotton acreage, erecting chemical plants to produce new mineral fertilizers, expanding spinning

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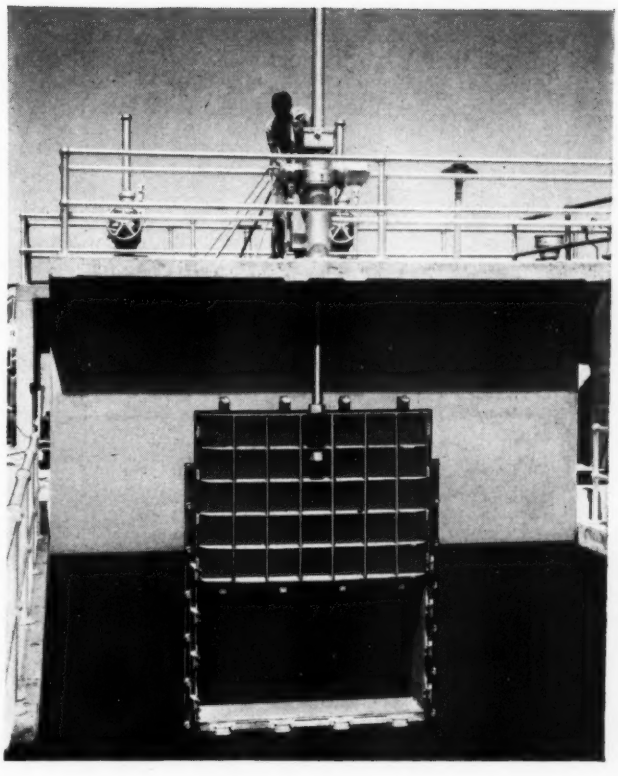

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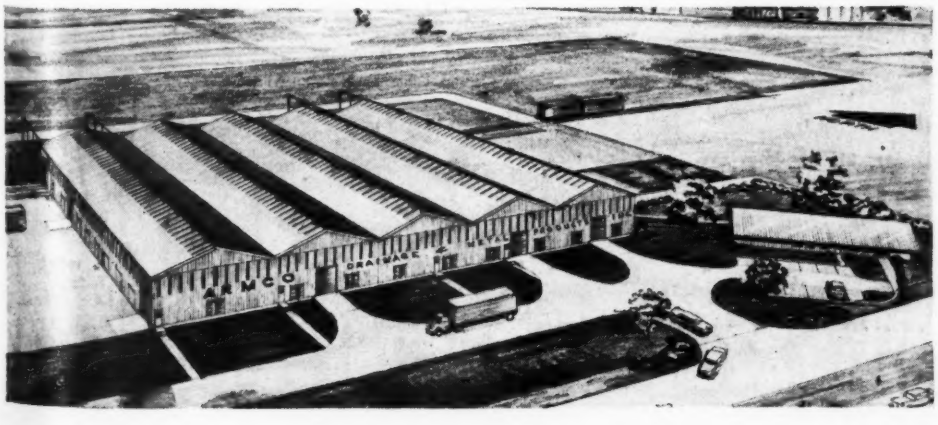

Artist's drawing of new plant in Denver, Colorado. Here Armco Gates are produced by the most modern equipment.

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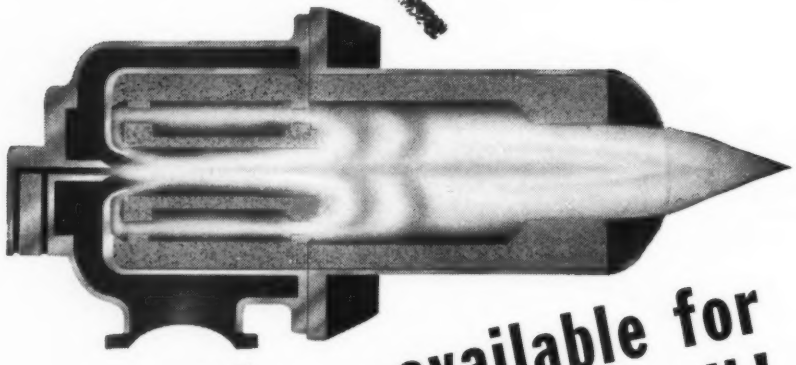

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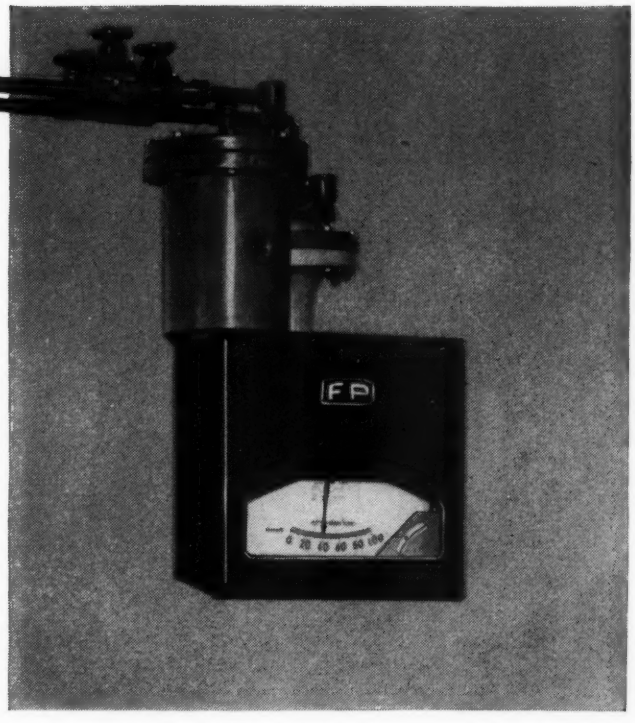
and weaving facilities, boosting steel output to stock machine-building plants making textile machines. . .

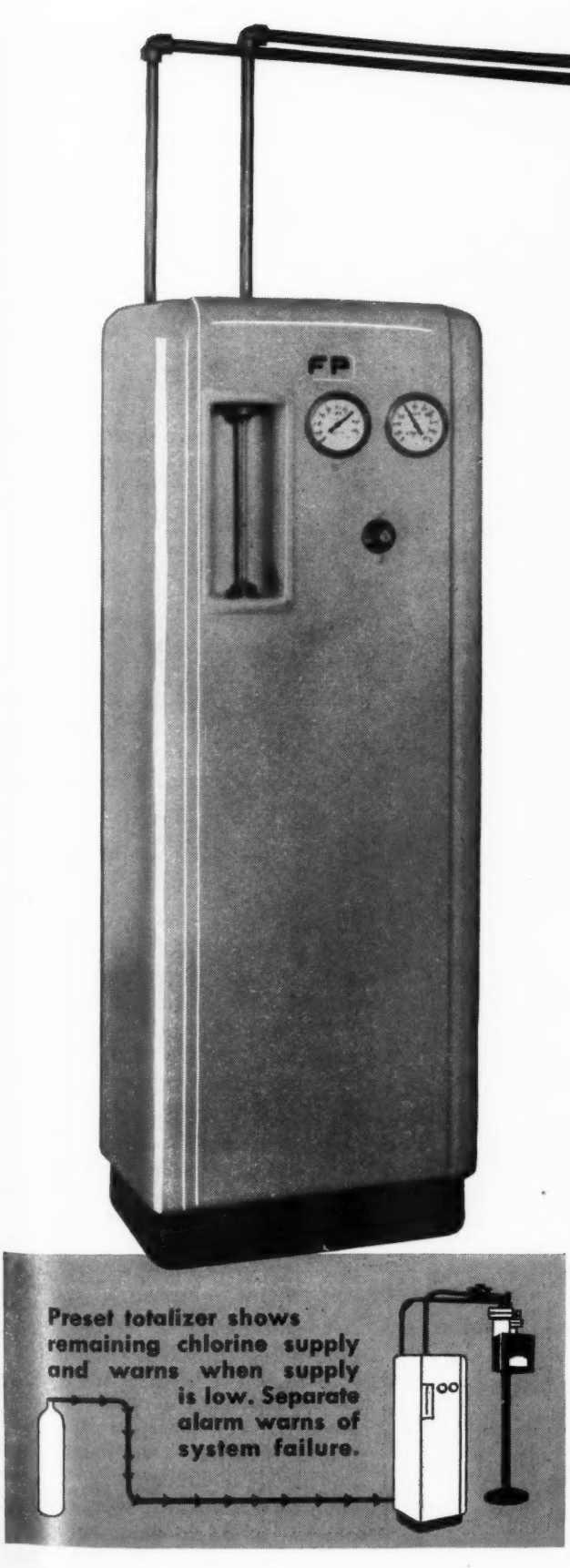
Plant-level consultation is promoted by the ministries when production of a given plant is to be boosted or reorganized. This is sometimes done by sending out technical assistance brigades made up of various engineers and specialists who spend a few months at the plant working with the local personnel and devising suitable methods to meet the new production schedule. Engineers also may be enlisted in a program of retraining machine operators who are assigned to handle a new type of work.

Technical Council

At the ministry level consultation is a regular function of what is called the Technical Council of the ministry, which meets regularly under the chairmanship of a vice-minister to discuss progress and problems in the current program. An example of ministry-level consultation is a recent session of the Technical Council of the Ministry of the Oil Industry USSR as reported in the ministry house organ *Neftyanoye Khoziaistvo.*

The journal said that the Technical Council discussed further improvements in operation of centrifugal electric depth pumps and "acknowledged it was necessary to apply to the Ministry of the Electro-technical Industry with a request to increase the output of motors and other parts for electric depth pumps to meet the needs of the oil industry." Reporting further, the journal said that the Council discussed problems of protecting oil pipelines from stray currents and also remote control of oil pipelines, and "heard reports of representatives of the oil sales department, the All-Union Research Institute of Petroleum Construction Works, the Ukrainian Gas Pipeline Designing Bureau, the Telegraph Office, the Chief Administration of Railways, and the Scientific-Research Institute of the Ministry of Railways." After discussion, the journal said, the Council "acknowledged it necessary to re-

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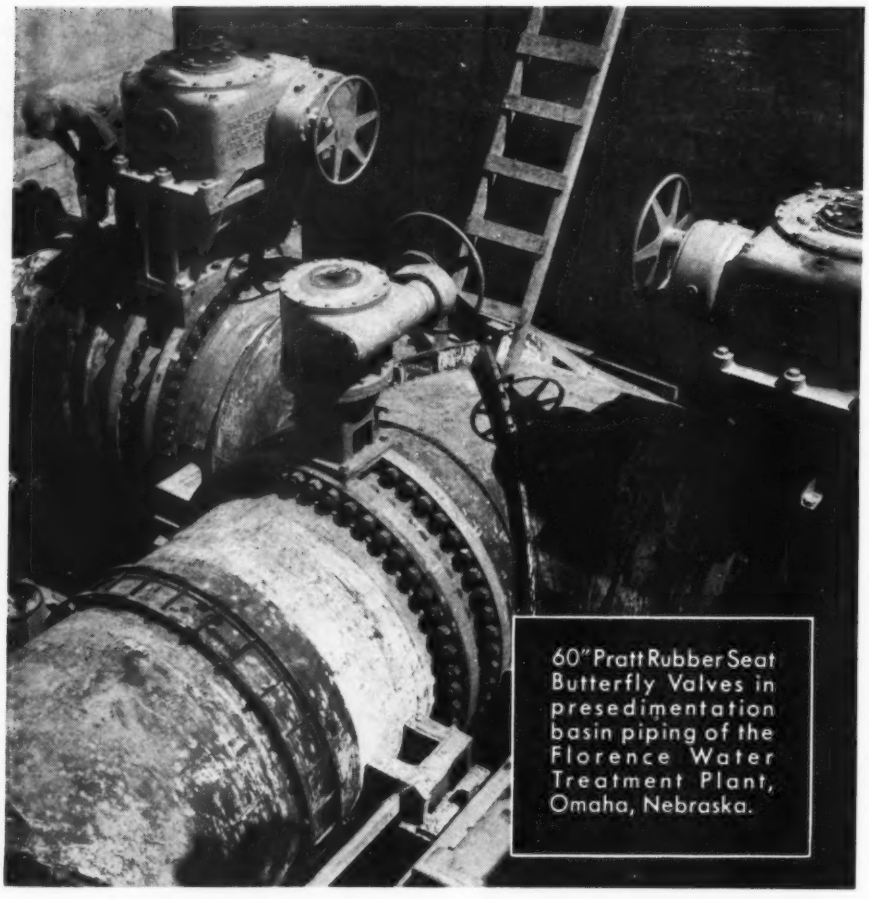
60" Pratt Rubber Seat Butterfly Valves in presedimentation basin piping of the Florence Water Treatment Plant, Omaha, Nebraska.

OMAHA... Butterfly Valves are key to compact piping

This ultra-compact arrangement of three 60 inch valves could only be made with Butterfly Valves. The illustration shows the narrow face-to-face dimensions (only 15") and the compactness of the valve-operator assemblies. What you can't see is equally important! The rugged internal construction—the rubber seat that is never under severe pressure from the valve disc, only partially displaced during closure... features that mean years of easy operation without maintenance problems or costs.

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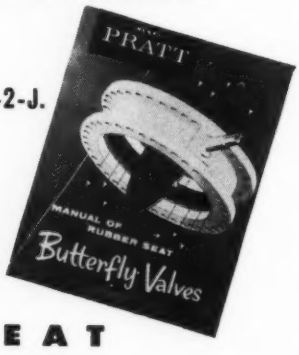

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quest that the Ministry of Railways and the Ministry of Transport Construction secure strict observance of the rates of the drop of potential in the rails of electrified railroads and adopt urgent measures to reduce the leakage of current from the railroad rails into the soil."

Institute Level

Consultation on engineering problems also takes place at the institute level among the various scientific research institutes founded in each of the principal ministries to promote technical investigation and new development within each individual industry. The research institutes usually function jointly with special educational institutions that train the industry's specialists. At this level there is close contact between the research institutes of industry and the various research institutions of the Academy of Sciences USSR; the former being more on the practical side, the latter more in the field of theory.

High Status of Engineering

Thus, under each respective ministry there is a corps of specialist engineers. In the Soviet hierarchy of industrial management, the engineering profession ranks in the upper brackets with respect to administrative responsibility, material remuneration, and Party membership. Each of these facets bears illustration.

It is now the rule for the director of a heavy industrial plant to be a graduate engineer. He is appointed to that position by the ministry in which he works. Soviet-trained engineers, most of whom come up through the industry's own personnel training system, are thus the captains of Soviet industry. In addition, trained engineers serve in such staff positions as chief engineer, chief mechanic, technical director, and shop foreman. Moreover, the proportion of engineering and technical personnel in Soviet industry to the total number of employees is constantly rising, owing to the growing complexity of industrial processes. It is estimated that more than one-fifth of the fore-

Unretouched photo showing typical return line corrosive action resulting from carbonic acid and dissolved oxygen in condensate.

BREAKING DOWN WITHIN

This section of pipe looks like new—on the outside. But take a look inside. Grooving action caused by carbonic acid and deep pitting, the result of dissolved oxygen attack, have almost completely penetrated the pipe wall.

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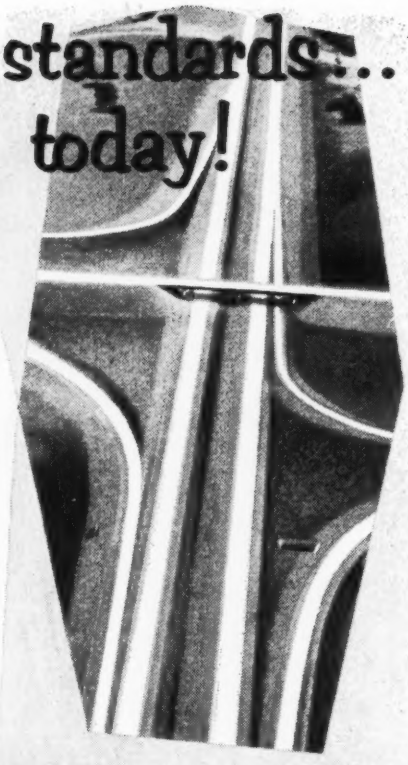

The Ohio Turnpike is the newest link in a national chain of superhighways that will eventually tie East to West. The most modern concepts of traffic engineering are reflected in the construction of this magnificent road. What transformers are used for service and lighting? Marcus, of course!

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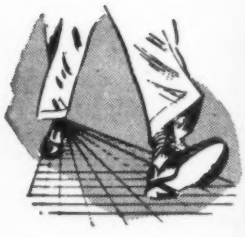

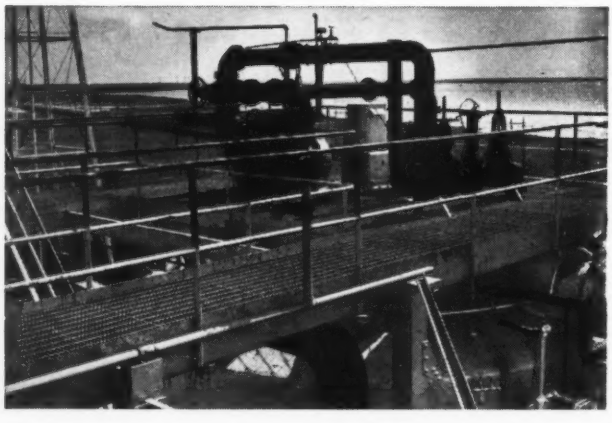

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men, section chiefs, and shop superintendents in USSR industries are trained engineers.

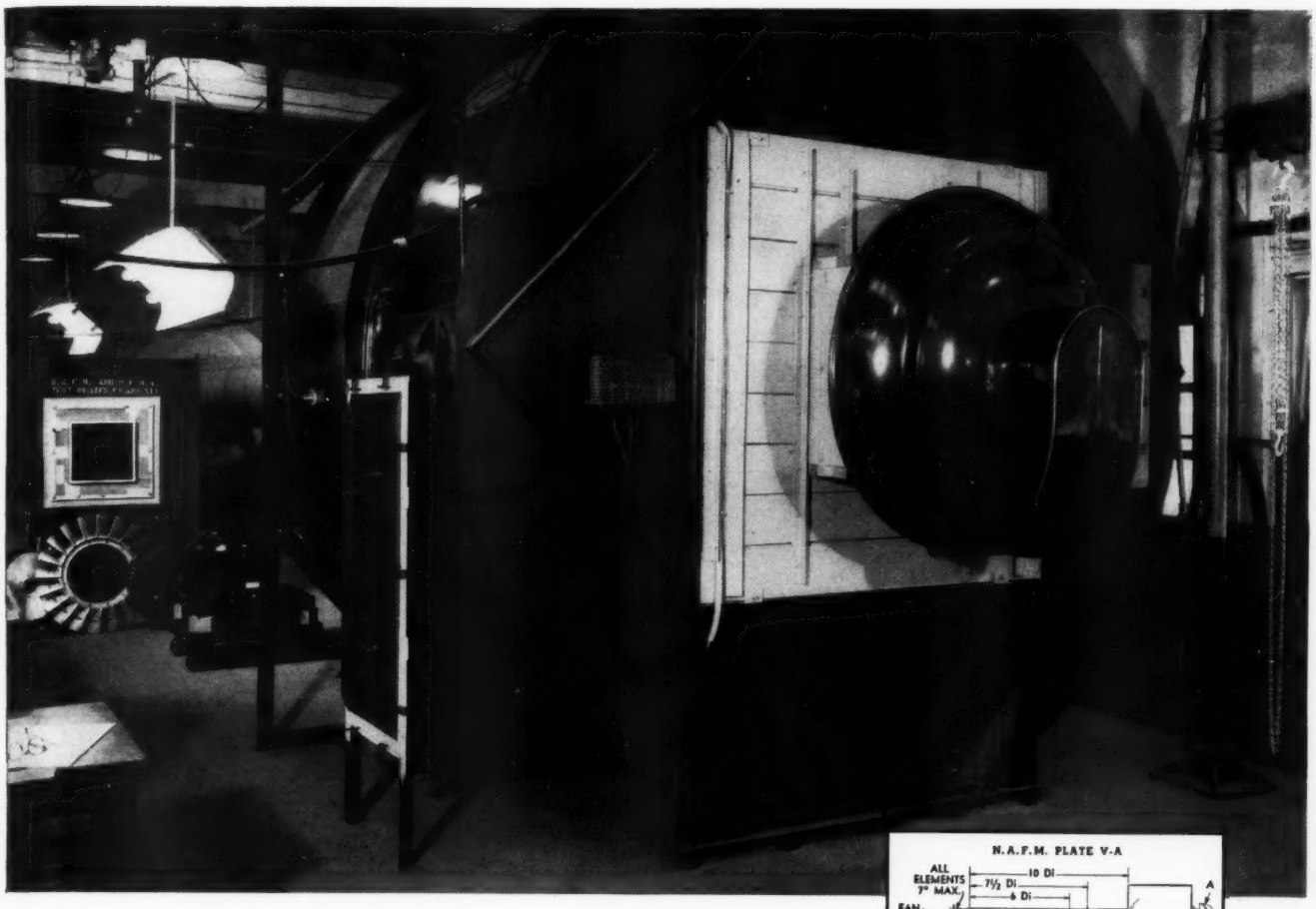
High Pay

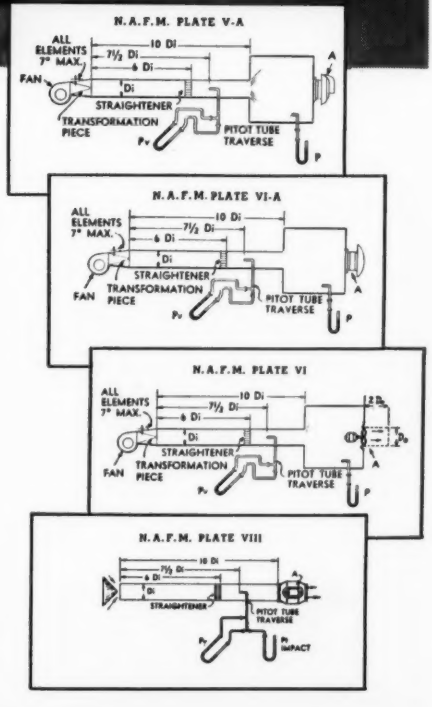
The eminent position of the Russian engineer finds expression also in his earnings which range from 1500 to 12,000 rubles per month, depending on position, according to the reports of recent visitors to USSR, including the New York attorney, Marshal MacDuffie, who reported his findings in *Colliers* magazine. Compiled from these reports, the following typical scale of monthly earnings shows that engineers rank well above the average. (Official exchange rate is 4 rubles for $1.00).

Rubles	
700-1000	Average Russian worker's wage per month.
1500-2000	Draftsman, bricklayer.
2000-2500	Top grade welder, forge shop foreman.
2500-4000	Staff engineers, steel molder, coal miner, editors, most judges.
4000-6000	Technical director, chief engineer, medical specialist, writer, scientist.
6000-12000	Executive of major plant or farm, city architect, university professor.

Payment to engineering and technical personnel is in the form of a staff salary plus a bonus for job completion ahead of schedule. How this system is set up is illustrated by the position of the shop foreman. Foremen receive a fixed salary of 2000-2500 rubles a month, but they get an additional payment if the output program is completed—10 percent more for every one percent of actual output in excess of plan. The basic rates, moreover, increase with seniority at the rate of 10 percent for 5 years seniority and 20 percent for 10 years seniority—up to a total of 40 percent.

An engineer who holds the position of executive director of an industrial plant enjoys the addi-





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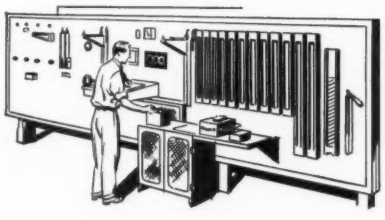

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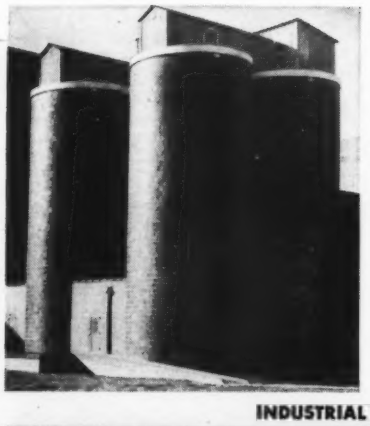

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tional remuneration of free residence in a state-owned house and use of a chauffeur-driven automobile. These privileges go with any executive position.

Working Agreements in Foreign Lands

If Russian engineers at home function within a tight system of collective management relationships, they are no less bound to the body and policy of the Soviet state when they engage in promoting state-sponsored technical aid in lands outside the USSR. The arrangements under which they work in foreign countries are spelled out in the commercial agreements that the Government in Moscow, through its monopoly of foreign trade, concludes with the country that contracts for Soviet technical assistance.

Information on these arrangements is scanty. Yet, it is known that Russian specialists and technicians have figured in the recent arms deals with Mideastern countries like Egypt and Syria, not to mention the obvious role they are playing in Eastern Europe and China under the mutual-aid economic pacts the USSR has concluded within the Communist bloc countries.

Examples of Foreign Aid

Offers of Russian technical aid were widely publicized last year during the state visits that Premier Bulganin and Party chief Khruschev paid to India, Burma, and Afghanistan. The offers were reported to have resulted in agreements for technical aid to these South Asian countries. Soviet-Indian "economic and technical collaboration" was reported to have expanded 15-fold as a result of the Soviet leaders' visit. The steel and oil industry in India are reportedly being aided by Russian engineers.

Engineering aid also is being given to Burma in the construction of irrigation works and an industrial plant, according to the Russian press. Moreover, Burma is said to have accepted the Soviet proposal "to build and equip, as a gift to the Burma Union's people, an Institute of Technology, in Rangoon," and in return Burma is supplying the USSR "an appro-

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Gold Bond® "Firefighter" Roof Decks are poured-in-place. Construction is fast...*as much as 30,000 sq. ft. of gypsum can be poured in a single day.* These decks, installed by approved contractors, take full load capacity in less than an hour because of quick setting action. Whether you design a pitched, barreled or flat roof, "Firefighter" Roof Decks are completely adaptable. Their low dead load permits lighter supporting structures and allows substantial construction savings.

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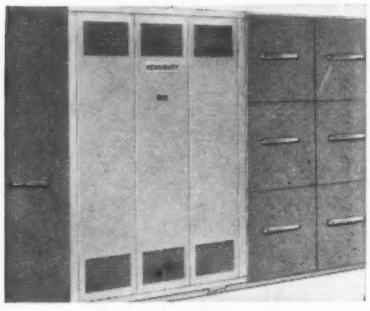

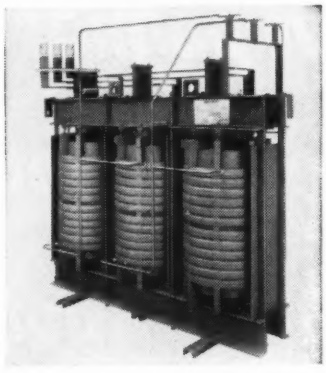

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Photo Right—Combination Drive application, Clintonville, Wisconsin.

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priate amount of rice and certain other goods as a gift to the people of the Soviet Union."

Another example is Afghanistan. After the Soviet leaders, during a stopover at Kabul, examined the problems of Soviet-Afghan collaboration in development of agriculture, hydroelectric power stations, irrigation works, and auto repair shops, it was reported that the USSR Government agreed in principle to give technical aid to the Afghans and granted Afghanistan a long-term loan of $100 million.

The Russians also are developing engineering relations along new lines with the Yugoslavs. The principles on which current activity is proceeding are set forth in the "Soviet-Yugoslav Science-Technical Collaboration Agreement" announced December 21, 1955. The agreement provides that collaboration be promoted "by means of exchanging experiences and technical achievements in industry, agriculture, and other economic fields, including the exchange of patents, licenses, and technical documentation according to the laws in force in each country, and by means of business missions on a reciprocal basis of specialists, practical engineers, and students." A Soviet-Yugoslav commission financed by both countries has been set up under the agreement to promote scientific and engineering cooperation, the commission to meet not less than twice a year, convening by turn in Belgrade and Moscow.

Since the framework in which the Russian engineer functions both at home and abroad is one in which his activity is controlled by the state, it cannot be expected that he will be less a promoter of the Soviet state's interest abroad than he is at home, where being an eminent member of the management hierarchy, he has a big stake in the progress of the Soviet system. We might say that the Soviet engineer is as enthusiastic a supporter of the communistic system as the U. S. engineer is of his capitalistic economy. As a privileged member of a special privilege group, the engineer in Russia is not promoting any change. ▲▲

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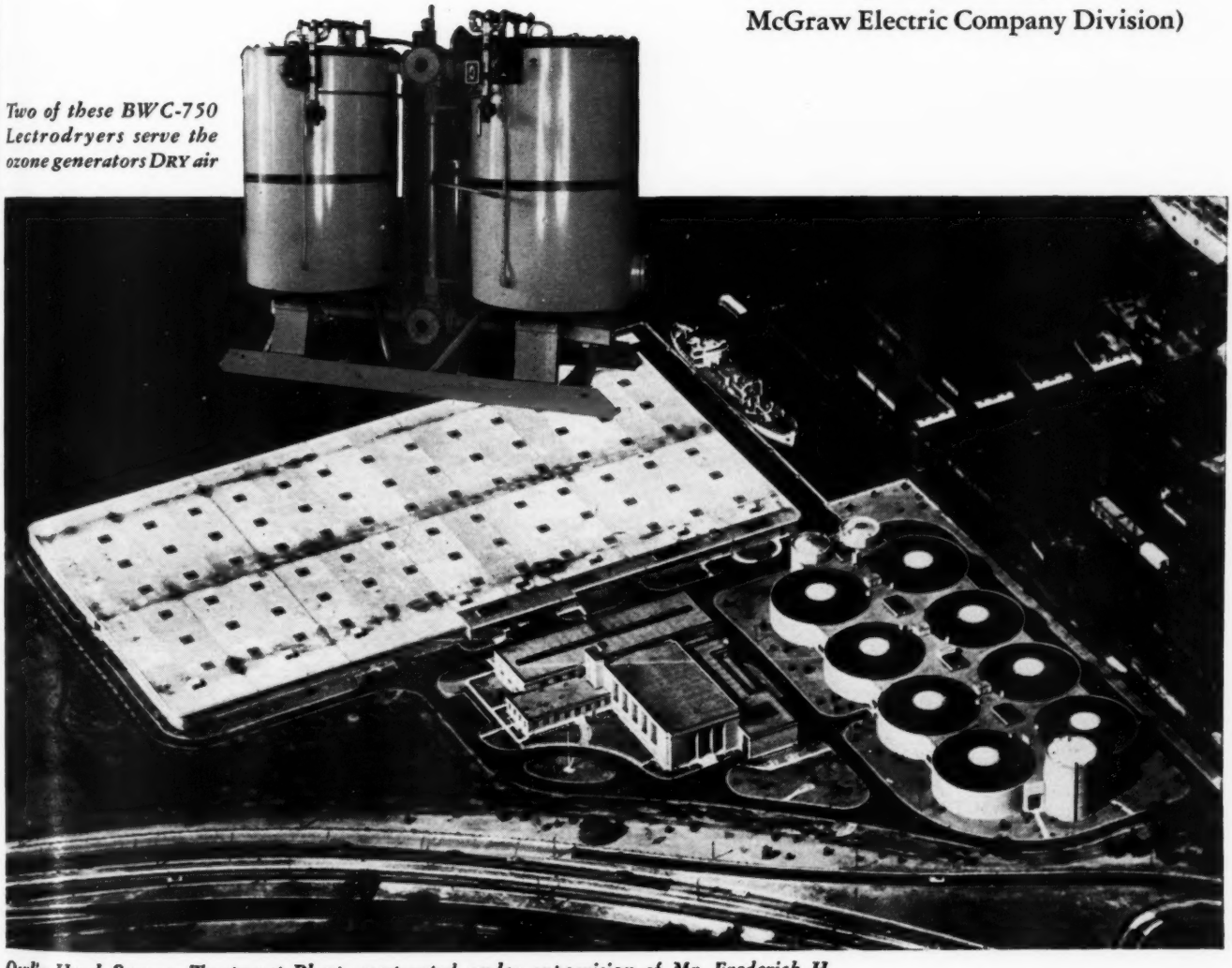
Two of these BWC-750 Lectrodryers serve the ozone generators DRY air



Owl's Head Sewage Treatment Plant constructed under supervision of Mr. Frederick H. Zurmuhlen, P.E., R.A., Commissioner of Public Works, City of New York.

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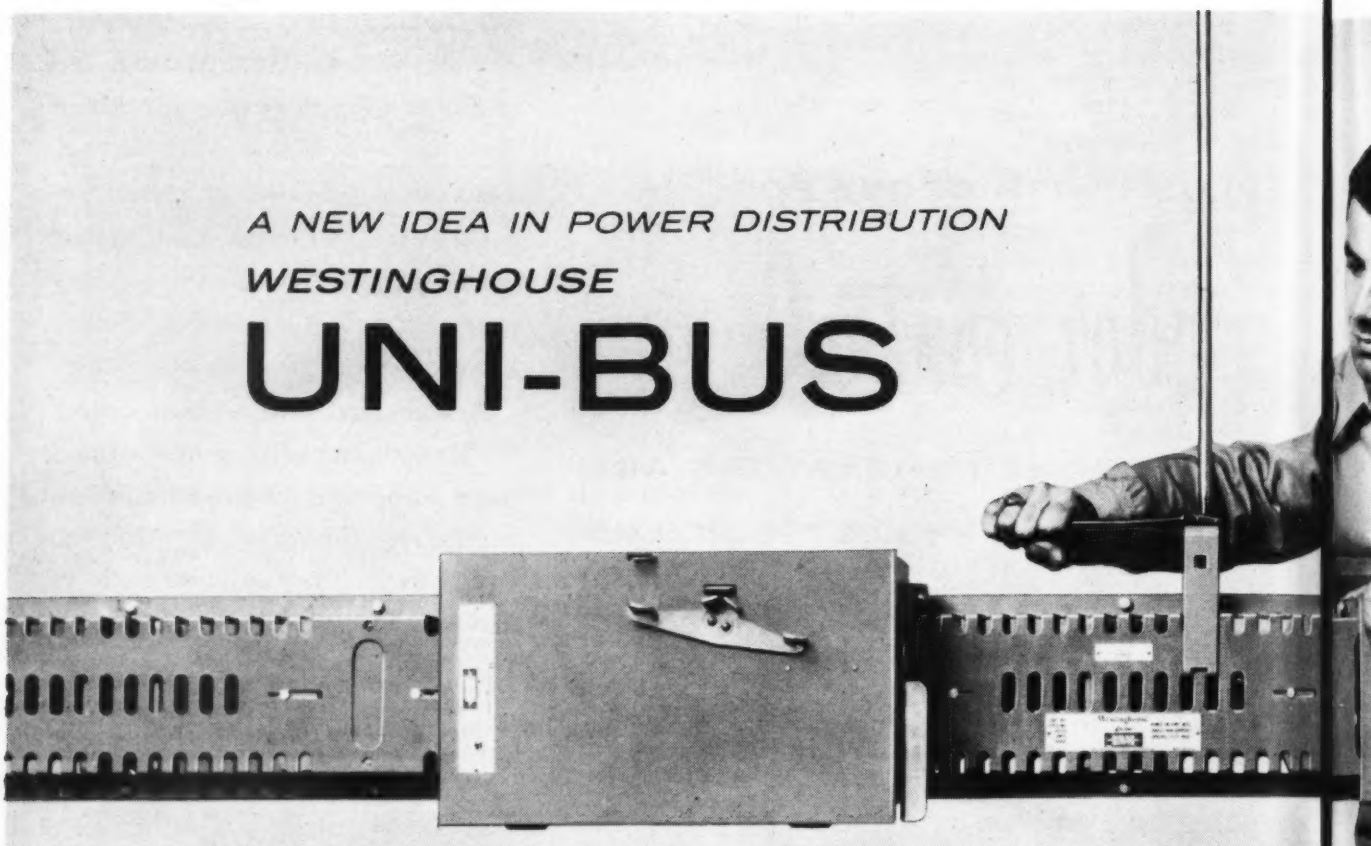

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For the first time, it combines the advantages of plug-in duct with a low-impedance system.

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Uni-bus is the only completely safe busway because it is impossible for anyone to touch live parts through plug-in openings. Added protection is provided by the unique plug-in devices and triple-wrapped insulation on bus bars.

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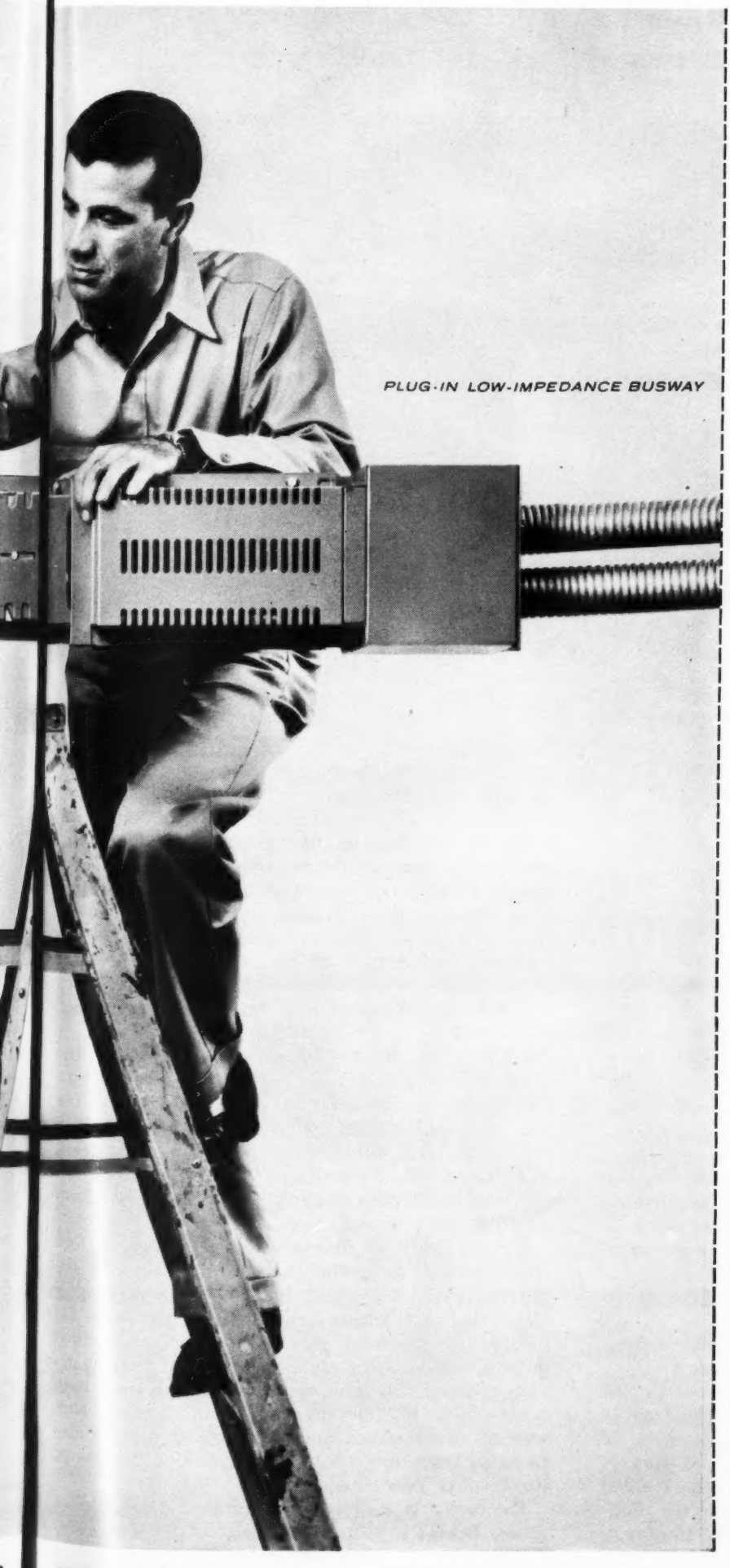
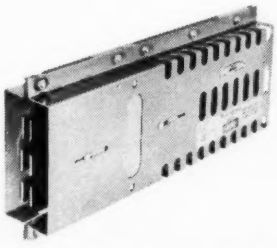


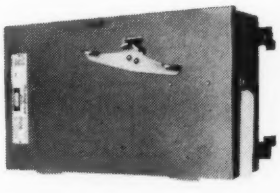
Construction details of Uni-bus, new power distribution system

Many reasons make Uni-bus unique in the busway field. Three exclusive features are detailed here:



Safety slide . . . Interlocking slide keeps plug-in openings closed until plug-in device is fastened to busway. Device cannot be removed when slide is opened. System has 12 outlets per 10-foot length.

Flexible connector . . . One unit does the job normally requiring many special fittings in other busways. The connector consists of two attachment boxes joined with flexible conduit and cable.



Uni-bus plug . . . Here is convenience and safety in one plug-in system. When cover is open no live parts are exposed. Contacts are visible in open position for positive identification. Contacts interlock so circuit is not opened or closed on bus bars.

At left is an illustration showing why Uni-bus is your best power distribution buy.

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News for the Consultant

Ideal Registration Law Up for Discussion at N.S.P.E. Meeting

Representatives of major engineering societies have been invited to participate in discussions on an ideal registration law and proposed rules of ethical conduct to be held in conjunction with the spring meeting of the National Society of Professional Engineers at the Francis Marion Hotel, in Charleston, S. C., February 14-16.

The all-day discussions on February 14 will center around the ideal registration law introduced at the National Society's 1956 annual meeting, and a compilation of rules of ethical conduct to assist in a better understanding of the Canons of Ethics for Engineers.

Clement J. Freund, dean of engineering at the University of Detroit, will speak on registration at a luncheon February 14.

Professional meetings begin February 15. Guest speaker for the banquet February 15 will be Major General Louis W. Prentiss, executive vice president of the American Road Builders' Association.

Arthur Fields, chief engineer of the Charleston Development Board, will speak at the luncheon February 16.

States Increase Use Of Welded Bridge Design

To determine the extent to which welding is being used for the construction of new bridges, the Lincoln Arc Welding Foundation recently conducted a survey through correspondence with all of the state highway departments.

The questionnaire asked to what extent welding was being used in these phases of construction:

¶ Use of welding for secondary members such as bracing, bearings, expansion devices, and shear attachments.

¶ Use of welding for cover plates on wide flange beams.

¶ Use of welding for the fabrication of plate girders.

¶ Use of welding for field splices of girders.

Of the 46 states responding, all used welding on secondary members, 35 made use of welded cover plates, and 22 are using an increasing number of welded plate girders for their highway bridges. A survey made by the Subcommittee on Welded Bridges of the American Association of State Highway Officials, in 1950, showed that at that time only 10 states reported using all-welded construction.

Arkansas has its first all-welded plate girder bridge with four lines of girders. Three spans are wide flange beams and eight spans are welded plate girders. Four additional bridges with welded plate girders have been placed under contract.

California has about 70 completely welded bridges.

Colorado has some welded bridges on the Denver-Boulder Turnpike designed by Howard, Needles, Tammen and Bergendoff.

Connecticut has, at last count, 29 all-welded bridges, and about 21 partially-welded bridges.

Florida has used welded bridges of various types on their state road system. Practically all of their I-beam spans are constructed with welded cover plates on the bottom flange and composite construction at the top flange, provided by means of welded shear developers. They also have 11 welded plate girder bridges. In addition, they have several other large plate girder spans under study.

Georgia recently built its first all-welded plate girder bridge using four lines of girders. Four spans are wide flange beams and four spans are welded plate girders.

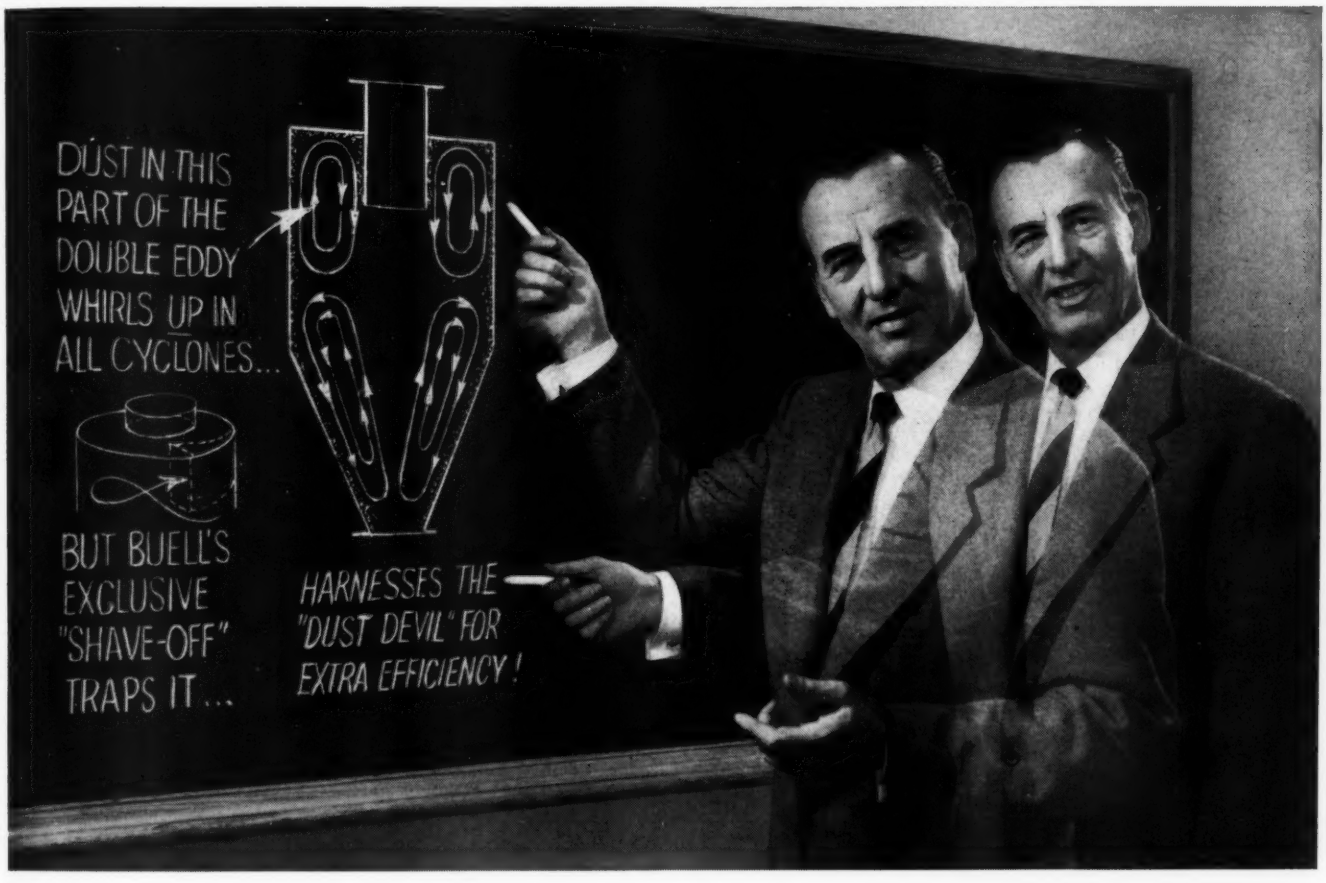
Illinois has designed and constructed its first all-welded steel plate girder bridge, a three span continuous bridge with ten lines of girders. The state has used welded cover plates for 20 years.

Iowa has used welded cover plates for many years. They have four welded plate girders already constructed, four more under contract, and six scheduled for early letting.

Kansas built its first all-welded bridge, a four span continuous girder bridge, in 1949. At the present time, the state highway system has 16 all-welded plate girder bridges. They also have 133 bridges of continuous wide flange beam construction having welded cover plates and welded bearing devices. During this time, the counties in Kansas have constructed 156 continuous I-beam bridges with welded cover plates and ten welded plate girder bridges. There are a total of 254 welded bridges on the Kansas Turnpike alone.

Kentucky is designing its first all-welded plate girder bridge.

Mastering the double-eddy dust devil leads to extra dust collection efficiency!


DUST IN THIS PART OF THE DOUBLE EDDY WHIRLS UP IN ALL CYCLONES...
BUT BUELL'S EXCLUSIVE "SHAVE-OFF" TRAPS IT...
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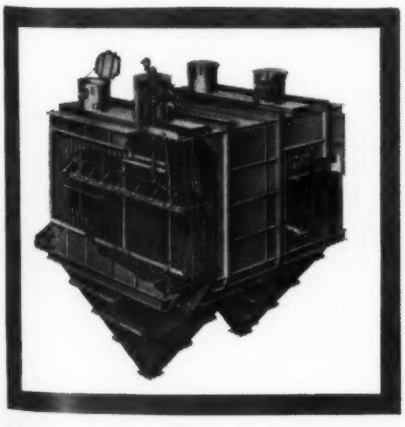
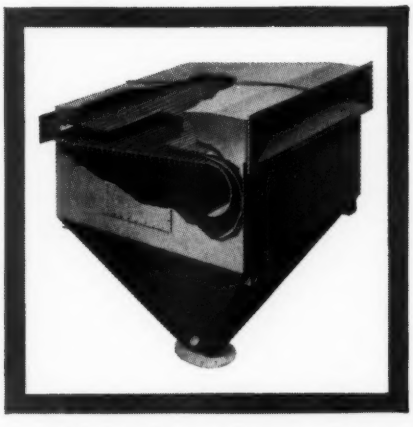


Buell SF Electric Precipitator also delivers *extra dust collection efficiency*, due to unique Spiralectrodes and Continuous Cycle Rapping.



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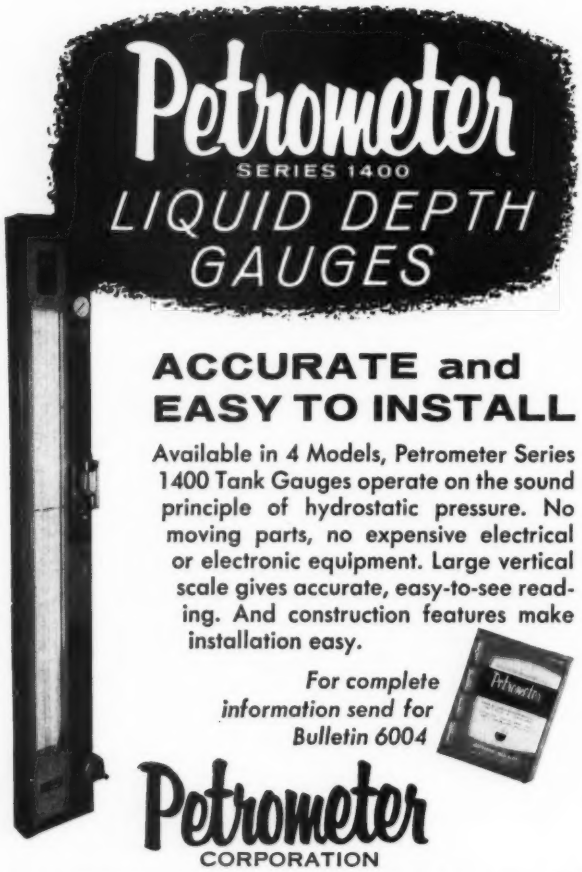

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P.L. ...a product of Colorado Climate

Louisiana has an all-welded plate girder bridge using A-242 steel. The New Orleans Terminal Project made wide use of welding on their overpass.

Nebraska constructed its first all-welded plate girder bridge in 1953. Since that time, they have ten of these completed or under contract, and six or more on the drafting table.

New York has erected nearly 80 welded steel bridges since 1942. Practically all of the 500 bridges on the New York State Thruway are welded. They also have a welded railroad bridge over the Cherry Valley Turnpike.

Ohio, in the past 20 years, has designed and built approximately 500 continuous steel beam bridges of three or more spans each, with welded splices over the piers, cover plates, welded bracing, railings, and expansion devices. Three pedestrian overpasses, of the all-welded thru-arch type, have also been constructed, the largest having a span of 205 ft. Recently an all-welded continuous girder bridge was placed under contract. Two additional welded girder bridges are now being designed, one with interior spans of 246.5 ft.

Oklahoma has under construction six welded continuous plate girder bridges and two welded girder bridges. Plans are completed for ten more of these and for two double continuous plate girder bridges.

Oregon has constructed six welded plate girder bridges ranging from 40 ft single spans to a continuous series 90-160-90 ft.

South Dakota has, for the past ten years, considered welding the conventional method for making structural connections on all of its bridges with the exception of truss spans.

Texas currently designs nearly every steel bridge with span lengths less than 160 ft for welded fabrication, with the field connections also welded. The designs are generally continuous deck structures involving one or two field splices in line of beams or girders. For span lengths under 90 ft, the stringers are wide flange beams; for longer spans, they are plate girders. They have under contract plate girder design bridges with span lengths up to 270 ft for which the girders are fabricated by welding, but the field splices in the girders are to be either riveted or bolted. Connections of the sway bracing and laterals will be provided with holes to aid in erection, but field connections will be welded.

In addition, the following states also have designed or are designing welded plate girder bridges: Massachusetts, New Hampshire, North Dakota, Rhode Island, Vermont, and Wyoming.

840 Cycle System Installed in Office Building

Speaking at the Winter General Meeting of the American Institute of Electrical Engineers, R. D. Burnham, of the Wakefield Co., Vermillion, Ohio, told a session on production and application of light that a 840 cycle frequency system was installed in a small industrial office building at lower initial cost, increased efficiency, greater flexibility, and a

How to simplify and cut costs of Your wall construction with

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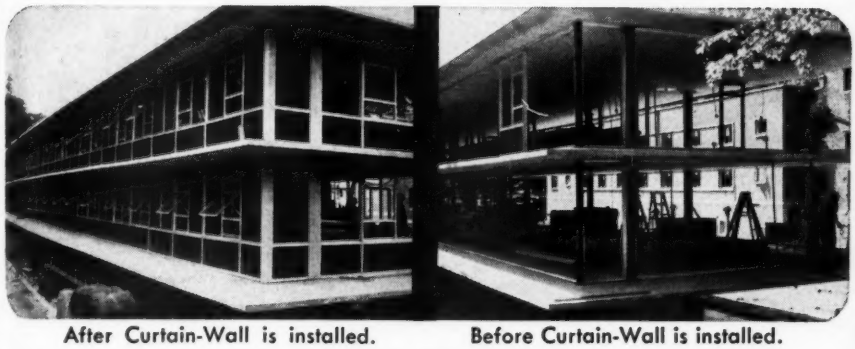

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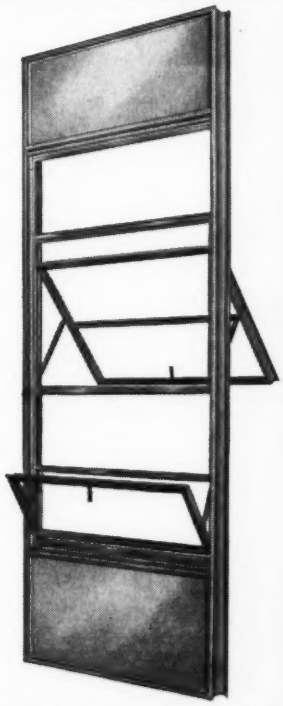
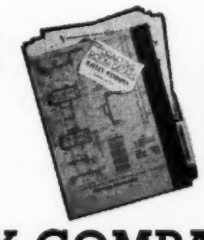


The Bayley Series A-450 Aluminum Curtain-Wall Unit.



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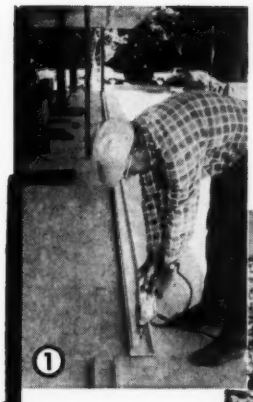

1. Bolting sill and header plate into position.
2. Bolting jamb plate to load-bearing column.

3. Interlocking window-panel into position.

4. Caulking interlock grooves before positioning mullion.
5. Positioning Bayley adjustable-width mullion.
6. Positioning window-panel — using interlock groove as slide.

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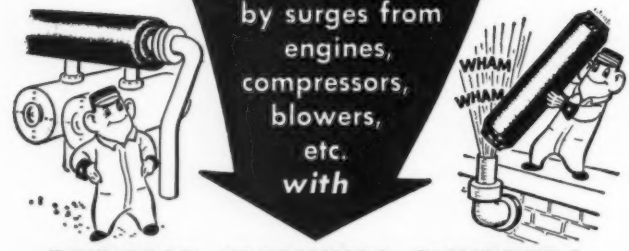

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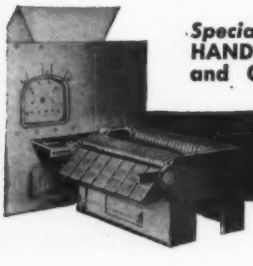

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PHONE Glendale 3-9133

20 percent power consumption reduction over a comparable 60 cycle system. The air conditioning load was reduced ten percent, and if lamp life proves to be longer it also will reduce cost.

Frequency conversion from 60 to 840 cycles was effected by utilizing a motor generator, instead of a static harmonic multiplier or an electronic multiplier, because of the lower initial cost, he said. A 400 volt, three-phase motor was used to drive an 840 cycle, 400 volt, three-phase generator. Capacitors were used for current limiting.

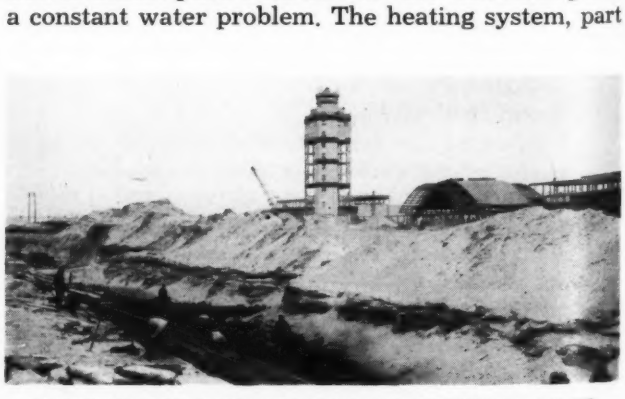
Noting that increasing frequency for the purpose of operating fluorescent lamps under more advantageous conditions seems to be practical with electrical components available today, Burnham stated that this pilot installation indicates that a high frequency system boasting of increased lamp efficiency and lamp life, reduced radio interference, elimination of stroboscopic effect, removal of ballast noise, and reduction in number and size of lighting fixtures could be installed for the same over-all cost as the usual 118 volt, 60 cycle system.

Since an electroluminescent luminous panel light source increases in brightness both with an increase in frequency and voltage, it is probable that when this new light source becomes practical for general use, it will be used first on a high voltage, high frequency distribution system.

He also predicted that improvements in circuit design and electrical components will be made, leading to new techniques.

Soil Poses Problems In Airport Heating Installation

In the design of the high temperature hot water heating system at New York's International Airport, Seelye, Stevenson, Value & Knecht, consulting engineers for the system, encountered many unusual engineering problems because of the type of terrain. Soil is almost pure sand and the low sea level poses a constant water problem. The heating system, part



LONGEST STRAIGHT PIPE RUN IN SYSTEM IS 110 FT.

of the $90 million expansion program at the airport, involves 7.34 miles of piping running from a central heating plant through the sandy soil under roads, runways, and walks, to each of the proposed buildings planned for the 655-acre site.

In the finished system, the water will be piped

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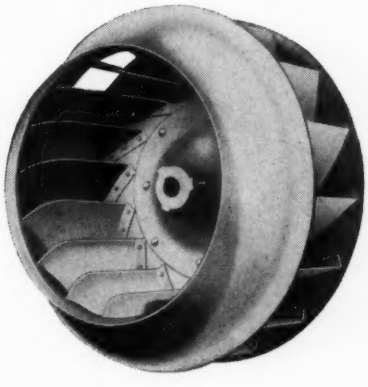

INLET — a smoothly curved bell shape with cantilevered inlet guide vanes curved to give air a spin into the wheel in the direction of rotation. No obstructions, no flat or rough spots to cause turbulence and entry loss.

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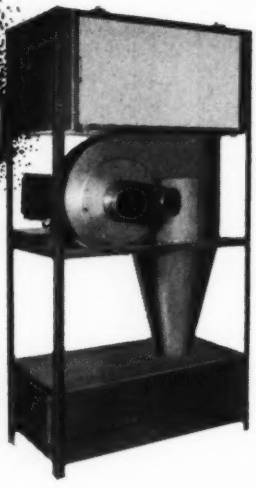

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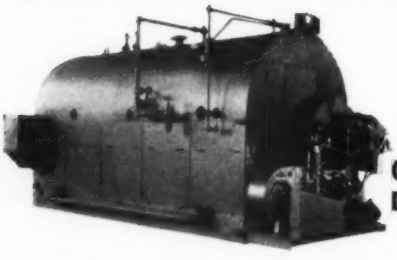

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Lbs. Steam per Hr.	700	863	1035	1380	2070	2450	2760	3500
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Lbs. Steam per Hr.	4400	5200	6210	6900	8639	10,350	14,000	17,500

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at 380 F and returned to the heating plant at 240 F.

Before the pipes were laid, concrete slab pads were placed the entire length of each trench. A wall of concrete slabs or blocks was then erected to serve as a trough for the pipes. Gilsulate insulation was poured around the trenched pipes and the area de-watered until the insulation had cured.

The heating system is expected to be in partial operation by June.

Soils Permeability Studies Planned

The Soils Laboratory, Division of Industrial Research, Washington State Institute of Technology, is undertaking a project to devise and evaluate various types of equipment and procedures for the study of soil permeability. Lack of standards in this type of soils study came to light when the laboratory was asked to determine permeability of the fine-grained soil to be used as the core of the Noxon Rapids Dam. Civil engineers in general are expected to benefit from the research, since permeability rates are important not only in design of canals, dams, and reservoirs, but in calculation of settlement and stability of buildings.

Heat Pump and Sewage Lagoon Designed for New Plant

The $2,300,000 plant under construction for Flick-Reedy Corp., at Bensenville, Ill., will incorporate the newest developments in heating, air conditioning, and sewage disposal.

Heat will be from an air-source heat pump, the first in the Midwest, that will utilize heat extracted from 250,000 cu ft of air per minute to hold interior

LAGOONS IN FOREGROUND FURNISH COOLING WATER.

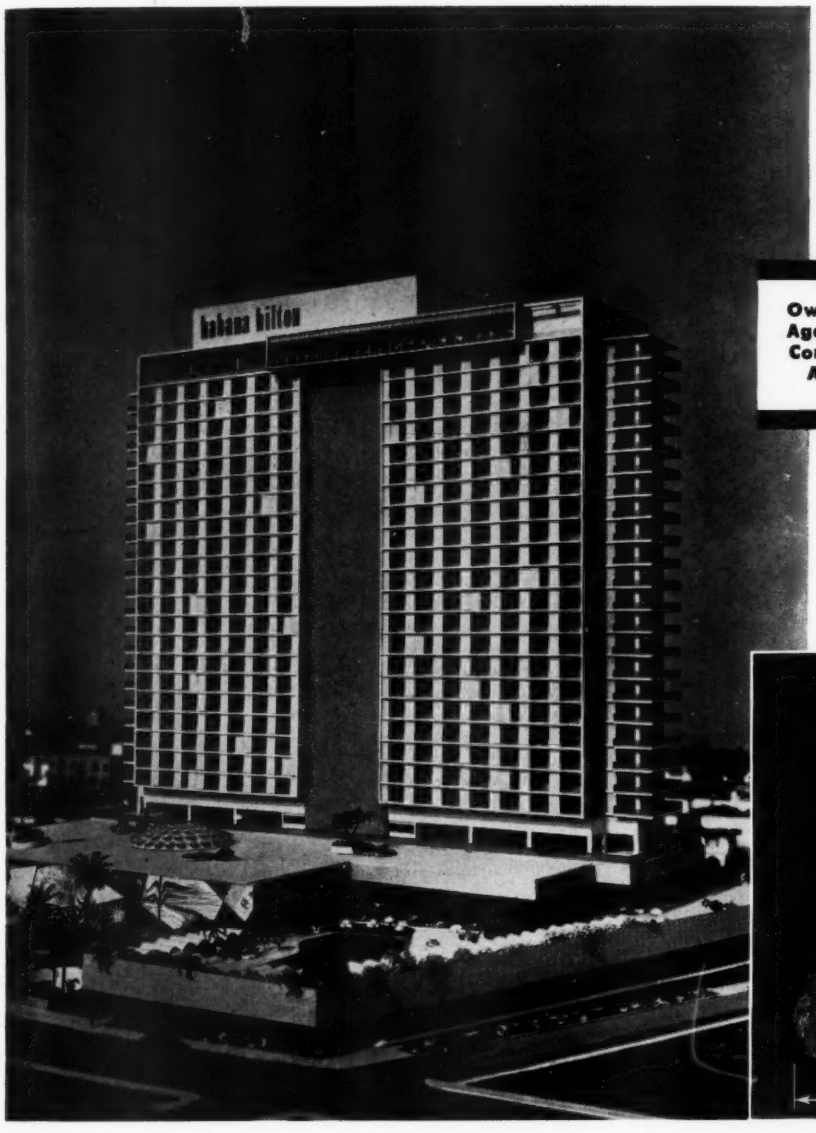
temperature at 70 F, with outdoor temperatures down to —10 F. The same pump will air condition the 220,000 sq ft of office and factory space in summer. It is being designed and installed by York Corp., subsidiary of Borg-Warner Corp.

Rainfall, to be collected in two man-made lagoons, will provide water needed for operation of air conditioning and for industrial use. Drainage from 10 acres of roof and parking area will feed the lagoons. The lagoons will be stocked with game fish and will be used for ice skating in winter.

A third lagoon, 75 ft wide, 500 ft long, and 7 ft deep, will be used for sewage disposal.

Engineer-architect for the project is Zay Smith & Associates, of LaGrange, Ill.

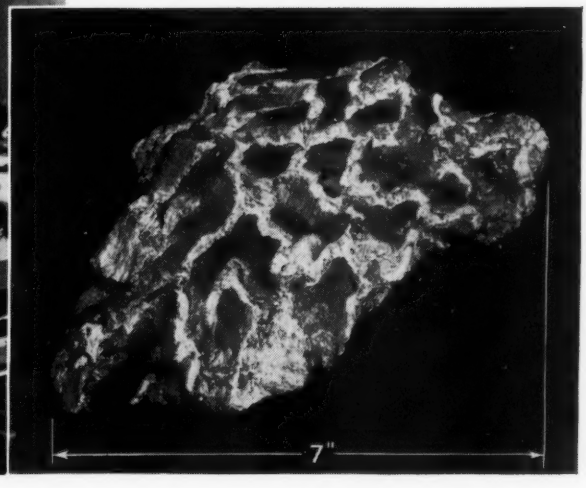
The new plant, with five times more space than the plant in Melrose Park, is expected to raise pro-



When completed in 1957, glamorous Habana Hilton Hotel will cover a full city block and be Cuba's largest. Resting on a firm INTRUSION-PREPAKT foundation, it will have 630 rooms in its 22 stories and be completely air conditioned.

Owner: Federation of Culinary Workers of Cuba
Agent and Contractor: Frederick Snare Corporation
Consulting Foundation Engineers: LeRoy Crandall & Associates and Prof. Jose Menendez

Unretouched photo shows how porous Pleistocene coral (white) was filled with INTRUSION grout (gray). Over one million gallons of INTRUSION grout were pumped into hotel foundation.



newest Hilton hotel rests on grout-intruded coral

INTRUSION-PREPAKT grouting techniques have assured a strong, stable foundation for the Habana Hilton now under construction in Havana, Cuba. The porous coral rock under this $14 million structure was strengthened by pumping some 147,000 cu. ft. of INTRUSION grout.

Faced with a foundation material that could not take the footing pressures, Consulting Engineer Jose Menendez called in INTRUSION-PREPAKT. With their extensive experience in foundation stabilization, I-P engineers demonstrated that grouting would provide the best and lowest cost answer to the problem.

All grouting work was done by trained INTRUSION-PREPAKT crews and completed on schedule. The use of INTRUSION grout with its high strength, excellent penetrability and ease of handling assured that all voids would be filled and maximum strength developed.

When difficult foundation problems arise, perhaps you, too, can save time and money with INTRUSION-PREPAKT methods and materials. For information, contact: INTRUSION-PREPAKT, Inc., Room 568-B, Union Commerce Building, Cleveland 14, Ohio. In Canada: INTRUSION-PREPAKT, Ltd., 159 Bay St., Toronto, Ont.

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• Above is an outstanding guide to good unit heater trapping. Note:

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2. **Dirt pocket ahead of trap** collects heavy sediment. No strainer needed—ordinary dirt washes right through an Armstrong trap.
3. **Test valve** provides easy trap check.
4. **Shut off valves and unions** allow trap repair without shutting off other units.
5. **An Armstrong Steam Trap** that discharges condensate at steam temperature, has large air venting capacity and will seldom require maintenance.

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duction of hydraulic and air cylinders by 70 percent.

Engineers Assigned to Jobs In U.S.S.R.

David M. Boyd, Jr., head of the Universal Oil Products Co. instrument department, reported, on his return from an instrumentation meeting in Heidelberg, Germany, details of technical training in Russia as explained at the meeting.

Russian educators told him the U.S.S.R. has graduated 5000 control engineers annually in recent years—about 10 times the number trained in U. S. colleges. They also confirmed estimates that the Soviet Union is graduating 75,000 engineers of all types annually. The three Russians—all faculty members of the Institute of Automatics and Telemechanics of the U.S.S.R. Academy of Sciences in Moscow—said there are about 120 professorships of control engineering alone in Russia.

The Soviet Union has attached strong monetary incentive to the study of engineering. From the description of the living standards of one of the three Russians—who holds a post corresponding to department head of a school of engineering—the man has a real income equal to $50,000 a year.

The Soviet professors said that all Russian children go to school 10 years and are subject to continuous, thorough examinations to determine which teen-agers go into the army, to factories and farms, or to college. Those who make highest grades are paid to go to college, but their courses are selected for them on the basis of previous examinations and aptitude tests. Four times the number of engineers required by the state are enrolled in colleges, the Russians said, and 75 percent are weeded out during the four-year course.

After graduation the state decides who is to take graduate studies, teach, or enter industry. Russian industry has no recruiting problem, the Soviet professors pointed out. Engineers are assigned to their jobs by the state. Starting wages are high, with inexperienced engineers making five times as much as Russian truck drivers.

There's no teaching shortage, either, since teachers of engineering are paid more than practicing engineers. (Also see "Report from Russia," p. 121.)

Papers of Interest to CE's Planned for A.S.C.E. Convention

The national convention of the American Society of Civil Engineers in Jackson, Miss., Feb. 18-21, has planned a program of particular interest to consulting engineers, with emphasis on the national highway system, pipelines, waterways, flood control, structural design, irrigation design, and power.

This will be the first A.S.C.E. national convention at which the new Pipeline Division will have a program. Its papers will cover such phases as surge

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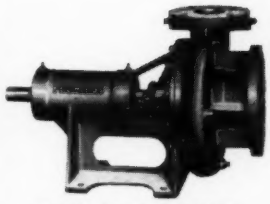
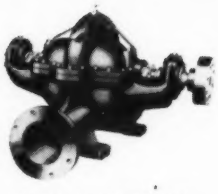
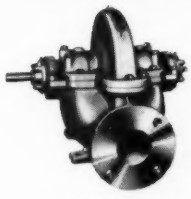
A complete line of electric close-coupled general purpose pumps. Threaded or flanged connections. Capacities: to 800 gpm; heads: up to 260 feet; motors: up to 50 h.p.



TYPE PB FLUIDYNE GENERAL PURPOSE PUMPS
Flexible coupled, single-stage, end suction, general purpose pumps. Rugged and durable. Capacities: up to 5500 gpm; heads: up to 260 feet; motor: up to 150 h.p.

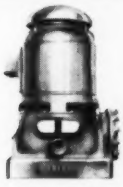


TYPE A GENERAL PURPOSE PUMPS
For application to the widest variety of pumping conditions. Single stage split case design. Capacities: up to 70,000 gpm; heads: to 300 feet. All types of drive.

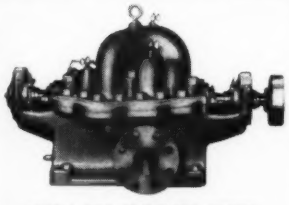


TYPE AS GENERAL PURPOSE PUMP
The centrifugal pump with mechanical shaft seals that eliminate the packing box. Up to 4" in discharge sizes. Capacities: up to 750 gpm; heads up to 210 feet.

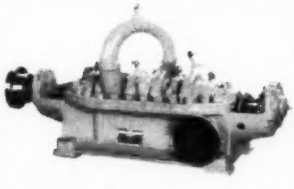
BY BUYING FROM THE COMPLETE LINE



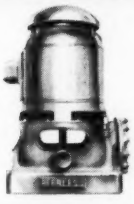
VERTICAL DEEP WELL TURBINE PUMPS
For application to deep well pumping. Lifts from 1000 feet or more. Capacities: up to 30,000 gpm. H.P. range: up to 1000 h.p. oil and water lubricated types. Widest range of sizes.



TYPE TU BOILER FEED AND PROCESS PUMP
2-stage high pressure pump for water and other liquids. Capacity: 50 to 3500 gpm; heads: up to 600 feet. Internal cross over is built into top half of pump case.

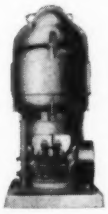


TYPE TUT MULTI-STAGE PUMPS
3, 4 and 5-stage pumps for water handling and process services. 1" to 5" discharge sizes. Capacity: up to 1350 gpm; head range: up to 1600 feet. Split case design.



INDUSTRIAL SERVICE PUMPS
For application to pits, sumps, basins, reservoirs and other surface water sources. Same capacity as deep well turbine above. H.P. range: up to 2500 h.p.

HYDRO-LINE PUMPS
An enclosed, close-coupled, vertical centrifugal process pump for handling petroleum hydrocarbons, where NPSH is limited. Capacities: to 6000 gpm; heads: to 1500 feet.



HI-LIFT PUMPS
The unique positive displacement deep well pump that literally squeezes water upward. Capacity: 10 to 55 gpm; lifts: up to 1000 feet. For wells 4" in diam. and up.

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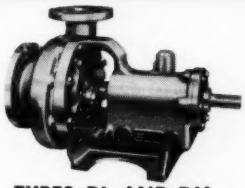

TYPES DL AND DM PROCESS PUMPS
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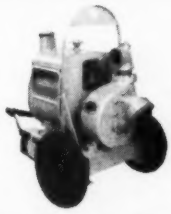

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pressures in oil pipelines, fluid mechanics, new materials for pipelines, hydrostatic testing, and pipeline river crossings.

Highway papers will include information on photogrammetric mapping, interstate highway standards, controlled access highways, and use of technicians in highway engineering.

Surface and ground water resources and waste disposal are two of the topics to be covered in Sanitary Division papers.

Consulting engineers and Corps of Engineers spokesmen will discuss flood control for the Mississippi-Yazoo Delta, Missouri River reservoir operations, the Mobile harbor and ship canal, and the Mississippi River Gulf Outlet.

Success of its technical conference type program last June encouraged the Structural Division to prepare similar sessions for this conference, with fourteen papers devoted to design of highway bridges.

Other divisions presenting papers are Power, Surveying and Mapping, Construction, Irrigation and Drainage.

During the convention, the Department of Conditions of Practice will hold a symposium on recruitment of graduating engineers and a panel on prospective engineering students.

ARTICLE REPRINTS

For free copies of reprints listed below, write on company letterhead to Reader Service Dept., CONSULTING ENGINEER 227 Wayne St., St. Joseph, Mich.

"More Money for Private Enterprise Abroad"
"Gas Turbines in Electric Utility Plants"
"Curricula for Budding Consultants"
"Estimating Drafting Costs"
"Sewage Lagoons are the Answer"
"An Engineer Looks at Foreign Aid"
"Private Plane Speeds Client Contacts"
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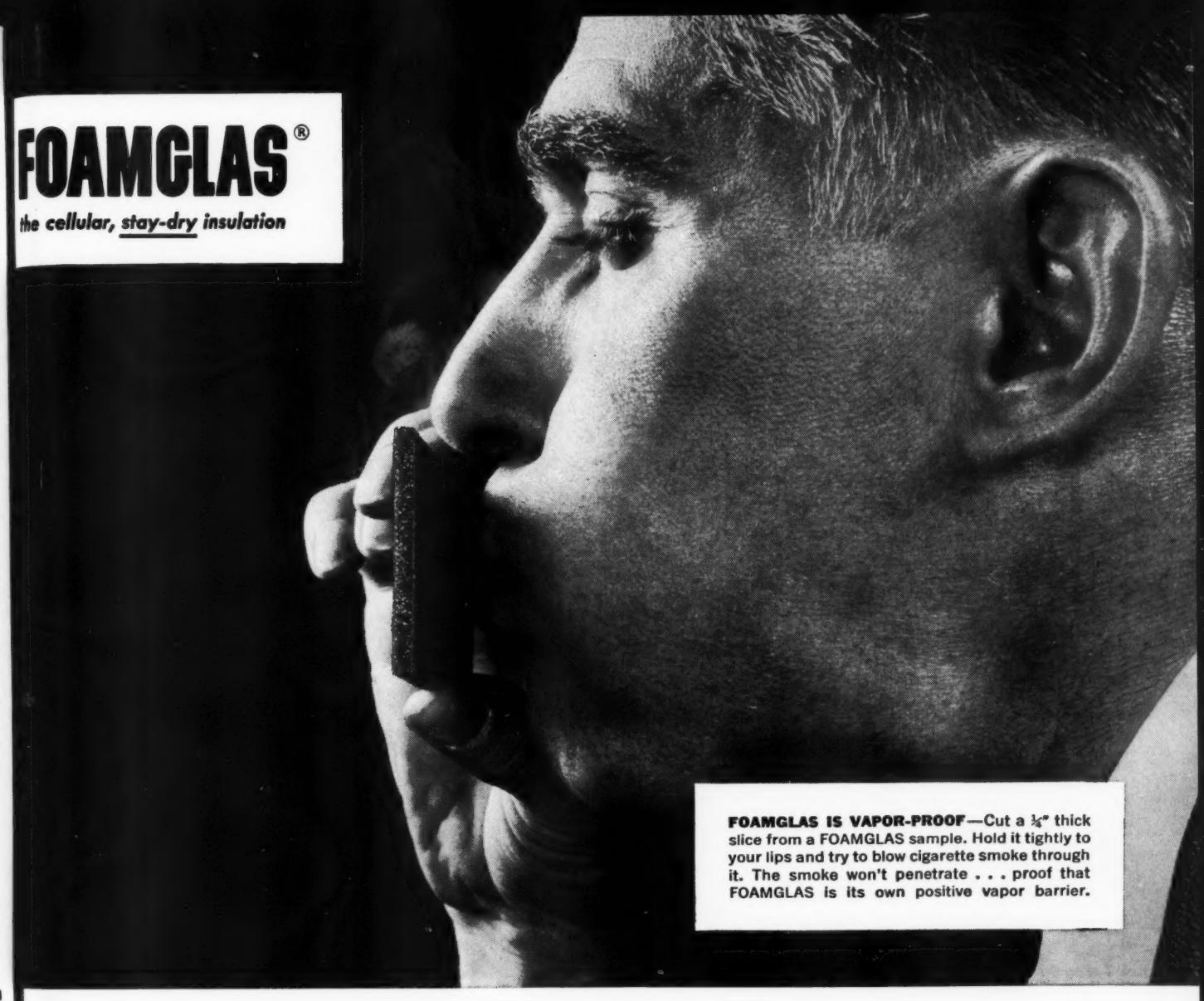

FOAMGLAS IS VAPOR-PROOF—Cut a ¼" thick slice from a FOAMGLAS sample. Hold it tightly to your lips and try to blow cigarette smoke through it. The smoke won't penetrate . . . proof that FOAMGLAS is its own positive vapor barrier.

Vapor can ruin ordinary insulations . . .

Prove to yourself that FOAMGLAS is vapor-proof!

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Nature exerts almost constant pressure to force heat and moisture vapor through a thermal insulation. Permeable insulations absorb that vapor. Even expensive vapor barriers cannot always insure absolute protection.

Once vapor enters an insulation —and condenses there—insulating value starts to nosedive . . . because moisture conducts heat. The *real* cost of a permeable insulation may multiply two or three times . . . in terms of lost insulating value and the resulting increase in heating and cooling costs.

That's why it pays to specify FOAMGLAS for true insulating economy. This unique all-glass insulation is naturally immune to vapor attack. Composed of millions of sealed cells, each a separate insulating unit, FOAMGLAS repels moisture in any form . . . liquid or vapor. Its insulating efficiency can never vary, and no costly vapor barrier is needed to protect it. Prove it to yourself with the simple test illustrated above.

In a few minutes, in your own office, you can test the whole combination of properties that makes FOAMGLAS unique among insulating materials. These properties have been proved not only by rigid scientific tests, but by hundreds of actual insulating applications. Send for a free sample and complete testing directions today. Address:

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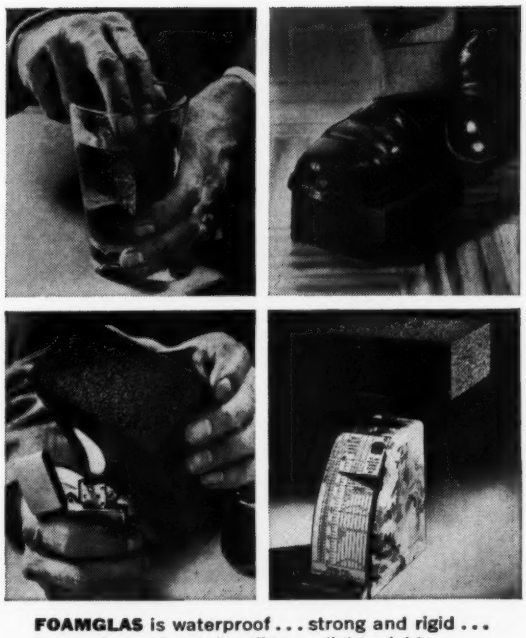
Pittsburgh 22, Pennsylvania
In Canada: 57 Bloor St. W., Toronto, Ont.



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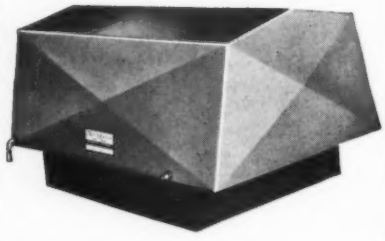

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MEN IN ENGINEERING

Eleven well known engineers have been named as sponsors of National Engineers' Week, Feb. 17-23. They are: Vannevar Bush, former president of Carnegie Institution of Washington; Allen B. DuMont, Allen B. DuMont Laboratories, Inc.; Charles F. Kettering, General Motors Corp.; James R. Killian, Jr., Massachusetts Institute of Technology; Clarence H. Linder, General Electric Co.; Thomas E. Murray, Commissioner, U. S. Atomic Energy Commission; Royal W. Sorensen, California Institute of Technology; Phillip Sporn, American Gas and Electric Company; David B. Steinman, Consulting Engineer; and Charles Allen Thomas, Standard Oil Company of Indiana.

Henry Gitterman has joined Burns and Roe, Inc., New York City, as a member of the Chemical and Nuclear Section.

E. Roger Hewitt, P.E., who has maintained a private practice since 1952, announces incorporation of his office as E. Roger Hewitt Associates, Inc. Offices are at 1110 South Pennsylvania, Lansing, Mich. Directors of the firm are Hewitt, Anton Krapek, and Elgin Clark.

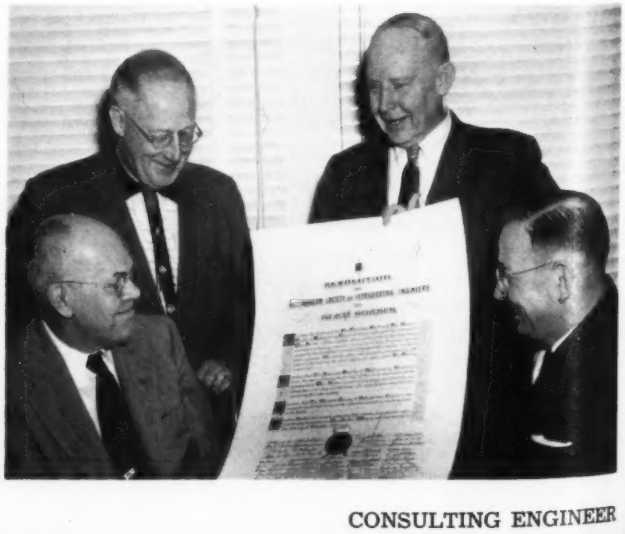
Sebastian L. Scheffer, senior electrical engineer, Burns and Roe, Inc., New York City, has been made a Fellow of the American Institute of Electrical Engineers "for his contributions to the control of transportation of bulk materials by rail and belt."

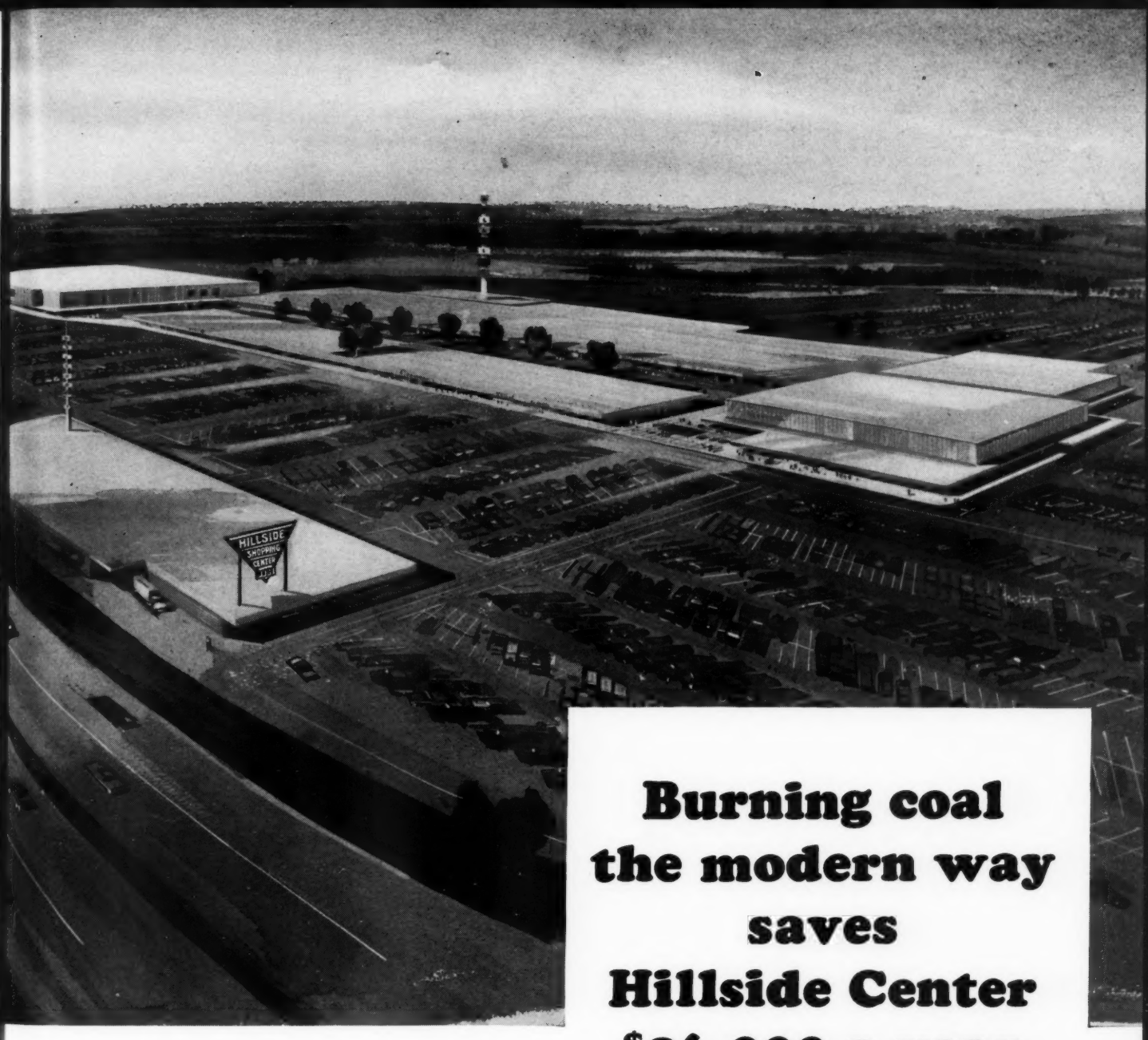
J. E. Hughes, vice president of Kaiser Engineers International, Inc., has been assigned to the development and execution of all company projects in Central and South America. Hughes will maintain offices at the Oakland, Calif, headquarters of the firm and will supervise offices in Buenos Aires and Asuncion.

Dr. J. Henry Rushton, professor of chemical engineering, Purdue University, has been elected 1957

Sorber Honored

For his contributions to the refrigeration industry, the American Society of Refrigerating Engineers presented Glen Sorber (seated, left), Berkeley, Calif., with honorary scroll. Standing, left, is Helmut G. Diehl, Refrigeration Research Foundation; standing, right, M. J. Copley, Dept. of Agriculture; seated, right, W. Hulse, San Francisco section, ASRE.





Burning coal the modern way saves Hillside Center $26,000 a year

The new Hillside Center, Chicago, Ill., is one of the country's largest and most modern shopping centers. Situated on a 59-acre site, it contains over 70 stores and offers parking space for nearly 5,000 cars. When Hillside Center was planned, exhaustive studies were made of prospective fuels . . . and it was decided to burn coal the modern way. For one thing, the initial economy of the mechanical system indicated coal. The cost of a complete coal system—boilers, coal and ash handling equipment, controls, etc.—fell within budget limitations. And, in view of limited space, the compactness of the system was an additional inducement. Finally, boiler room labor costs are at a minimum and actual operation savings with coal, compared to other fuels, is estimated at $26,000 a year.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

BITUMINOUS COAL INSTITUTE
Southern Building • Washington 5, D. C.

Note to consulting engineers:

Many companies planning a new power plant, or the remodeling of a present one, consult an engineering firm on its design and construction. When you have such a project, our Engineering Department will be glad to assist you in your fuel cost survey with any coal information you may require. In most cases, for the reasons listed below, the use of coal results in substantial savings in increased efficiency and fuel economy through the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum • Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

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president of the American Institute of Chemical Engineers. George E. Holbrook, E. I. du Pont de Nemours & Co., is vice president; Dr. George G. Brown, College of Engineering, University of Michigan, is re-elected treasurer; and F. J. Van Antwerpen, of Nutley, N. J., is re-elected sec'y.

Johannessen & Girand, Consulting Engineers, of Phoenix and Tucson, Ariz., have appointed Russ Scholtz as head of the electrical design department.

Dr. D. B. Steinman has made a grant of $10,000 to the Copper Union for the advancement of science and art. The fund will be used for scholarship loan purposes for engineering students of the college as well as for graduates who need financial assistance in pursuing graduate engineering studies.

The H. K. Ferguson Company has opened a new integrated engineering design office in Toronto, Canada. Rudolph W. Ullman, member of the company's Cleveland Staff, will head the new office.

JOHNSON

KORSHUS

The Minneapolis, Minn., consulting engineering firm of Nielsen and Bruch has announced appointment of Francis K. Johnson and Omer L. Korshus as Associates of the firm. Johnson is head of the Plumbing and Heating Division and Korshus is head of the Ventilating and Air Conditioning Division.

Gibbs & Hill, Inc. has opened an engineering office in the Wallace S. Building, Tampa, Fla. E. W. Southworth will be resident manager of the new office.

Foster D. Snell, Inc., Consulting Chemists and Chemical Engineers, have purchased Seil, Putt and Rusby, Inc., Chemical Consultants. Dr. Stephen S. Voris, president of Seil, Putt and Rusby, joins the parent organization as director of the new subsidiary.

Robert M. Wolaver has joined the industrial design division of J. M. Little & Associates, Maumee, Ohio.

A new engineering and architectural association, Beiswenger, Hoch & Burns, has been formed in Jacksonville, Fla. Offices are in the Prudential Building. Lester W. Foley is president of the new organization and David E. Russell is vice president.

Frank A. Bergey and Norton J. Taylor, mechanical engineers, and Maurice Lowell, architect, have been admitted to membership in the firm of Albert Kahn Associated Architects & Engineers, Detroit, Mich.

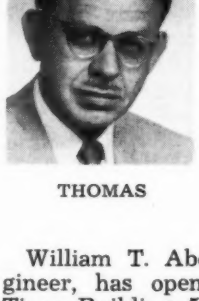
DARLINGTON

PHELPS

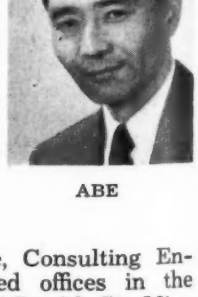
Dudley F. Phelps has been elected president of the J. G. White Engineering Corp., to succeed the late Ford Kurtz. Stephen P. Darlington succeeds Phelps as vice president in charge of engineering and G. H. O'Sullivan has been named vice president in charge of new business.

E. Warren Bowden has been elected executive vice president of Walter Kidde Constructors, Inc., of New York and Houston, Texas. He also will continue as a director of Walter Kidde Constructors, Inc., and vice president and director of Walter Kidde Engineers-Southwest, Inc.

Dr. B. D. Thomas has been appointed director of Battelle Memorial Institute, Columbus, Ohio. He succeeds Dr. Clyde Williams who remains as president of the Institute.

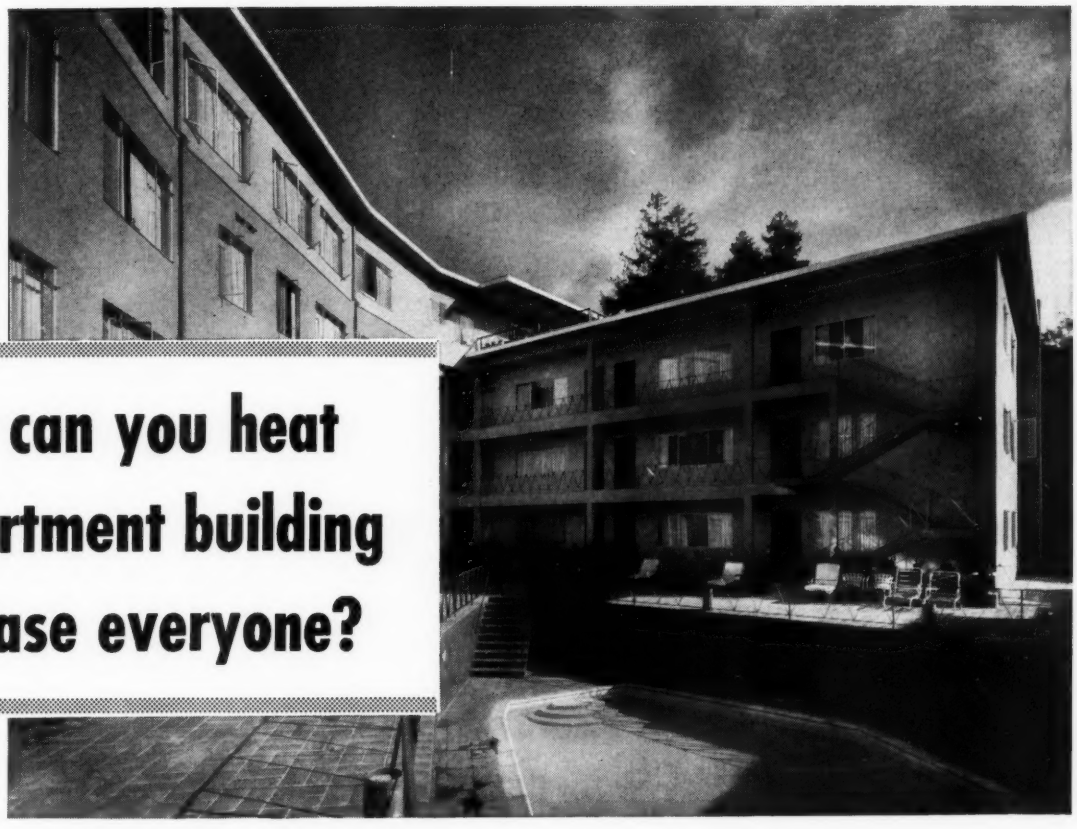


THOMAS



ABE

William T. Abe, Consulting Engineer, has opened offices in the Times Building, 55 So. 4th St., Minneapolis, Minn. His office will offer complete services in the fields of mechanical and electrical design for residential, commercial, institutional, and industrial buildings. Abe was formerly a member of the Minneapolis firm of Nielsen & Bruch, Consulting Engineers. ▲▲



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By letting each tenant select the temperature he likes in each room

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EVERY ROOM IS A SEPARATE HEATING ZONE with its own thermostat. Tenants can control the temperature according to their own preferences. The SelecTemp room heating unit automatically paces itself to supply just the right amount of heat needed. Unlike conventional "on-off" heating systems SelecTemp *modulates* from a slow "idling speed" up to full capacity. If one side of a building or home faces a cold wind while the other gets heat from the sun, the SelecTemp heating system automatically adjusts for this extra heat loss or gain *in each individual room.* In each SelecTemp unit the air is filtered, then heated by low pressure steam and circulated by a steam driven fan. There is no electric motor—both fans and thermostats are non-electric.

FOR ALL TYPES OF BUILDINGS AND HOMES Iron Fireman SelecTemp heating is ideal for any type of building or home, new or old. From the largest apartment, hotel, office or institutional building to the smallest residence, Iron Fireman SelecTemp system gives the same responsive and dependable service. It's a new, yet thoroughly proved method of heating that sets new standards of comfort and economy.

LOW INSTALLATION AND OPERATING COSTS. The installation of Iron Fireman SelecTemp in new or old construction is economical and practical. Installation costs are low. Overheating is eliminated and many owners report substantial savings in fuel bills.

FOR COOLING. Individual unit cooling with SelecTemp heating makes the perfect twosome for year 'round comfort.

Send for free literature. If you plan to build or modernize a building or a home, you owe it to your client and yourself to investigate Iron Fireman SelecTemp before deciding on any heating system. Don't miss the opportunity to learn about this great modern engineering advance in heating . . . Iron Fireman SelecTemp. Mail the coupon below.

SelecTemp room unit indicated by arrow.

Lee Street Apartments, Oakland, California.

"The installation presented an engineering problem," says Mr. Gordon Peterson, General Contractor, "as the boiler room is located at the extreme end of the building, a distance of 420 feet from the last SelecTemp unit. The system's flexible operation, its ability to heat only the occupied rooms, as well as its immediate response, is commended by our tenants. We feel that the SelecTemp heating system is the finest that has been devised for apartments" . . .

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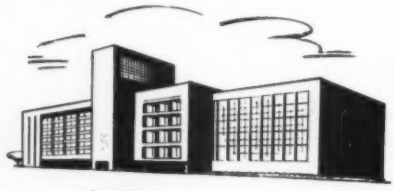
Building going up ...costs coming down

Marietta

CONCRETE WALL PANELS

Here's a new, modern building material that's slashing construction time and labor costs on every job. Marietta concrete wall panels are pre-cast in basic sizes either solid or with a rigid insulation core making them equal in "U" value to a 12" masonary wall. Cast-in metal inserts bolt directly to building framework and panels go smoothly together with tongue and groove fit for quick, easy erection in any weather. Pleasing architectural effects result from the broomed or colorful exposed aggregate exterior finishes.

Get the complete story on the many cost-saving advantages of Marietta wall panels . . . save as much as 30% in construction costs on your next building project. Marietta's engineering staff will assist you in your plans. Write for details and literature today.



THE Marietta

CONCRETE CORPORATION
Marietta, Ohio

BRANCH OFFICES: Baltimore 21, Md., Charlotte 6, N.C., Nashville, Tenn., Jamestown, N.Y.

New Projects Reported

By Consulting Engineers —

ALABAMA

Mosley & Yarbrough, Montgomery, Ala. Electrical and mechanical design for Opelika High School, Opelika, Ala. All electric heating system with baseboard elements in classrooms and blower type unit heaters with duct systems in auditorium and other large areas in the building. $1,000,000. Client, Pearson, Tittle & Narrows, Architects.

Electrical and mechanical design for office building, State of Alabama, approximately 230,000 sq ft, 600 tons of air conditioning with centrifugal water chilling machine and approximately 500 individual room fancoil conditioning units. $3,000,000. Client, Charles H. McCauley, Architect.

James A. Evans, Birmingham, Ala.
U. S. Post Office and Court House Building. Complete air conditioning, ventilation, and heating systems. Montgomery, Ala. $465,000. Client, General Services Administration.

Air conditioning, ventilation, and heating for Southern Bell Tel. & Tel. Co. Addition of three floors, with revisions to existing four floors. Mobile, Ala. $1,000,000 (est.) Client, Warren, Knight & Davis, Architects.

ARIZONA

O. W. Walvoord, Inc., Denver, Colo.
Design and construction of Old Dick mining and milling project located near Bagdad, Ariz. $750,000. Client, Cyprus Mines Corp.

James H. Howard & Associates, Houston, Texas.
Rehabilitation of old Phelps Dodge Corp. smelter at Clarkdale, Ariz., part of which will be made into a 2500 bbl/day dry process Portland cement plant. Design and supervision of construction. Joint venture with **Kent B. Diehl, Sr., Cement Consultant.** $4,000,000. Client, Verde Valley Industries, Inc.

CALIFORNIA

Hugh B. Brewster, Fresno, Calif.
Sewage disposal and water supply systems for new ski lodge located at Huntington Lake, Calif. $100,000. Client, Chilia Peak Corporation.

Grounds improvements at 22 schools, including sprinkler systems, asphalt paving, concrete work, grading, lawn planting, and drainage. Joint venture with **Bruan & Pasillas, Civil Engineers.** $200,000. Client, Fresno City Unified School District.

Morrison Maierle, Inc., Los Angeles. Preliminary design and investigation; route survey; construction plans and specifications; casting and construction supervision. $825,000. Client, City of Santa Barbara, Calif.

Harold A. Wright, San Francisco, Calif. Safeway food manufacturing center, Richmond, Calif.

First increment Superior Cheese plant. $300,000. Client, **Kaj Theill, Engineer,** San Francisco, Calif.

McNeil Engineering Co., Venice, Calif. Concrete tilt up factory building. $30,000. Client, Freyr Co.

COLORADO

Prengle, Dukler & Crump, Houston, Texas.
Gas processing plant, Akron, Colo. $500,000. Client, Akron Gasoline Co.

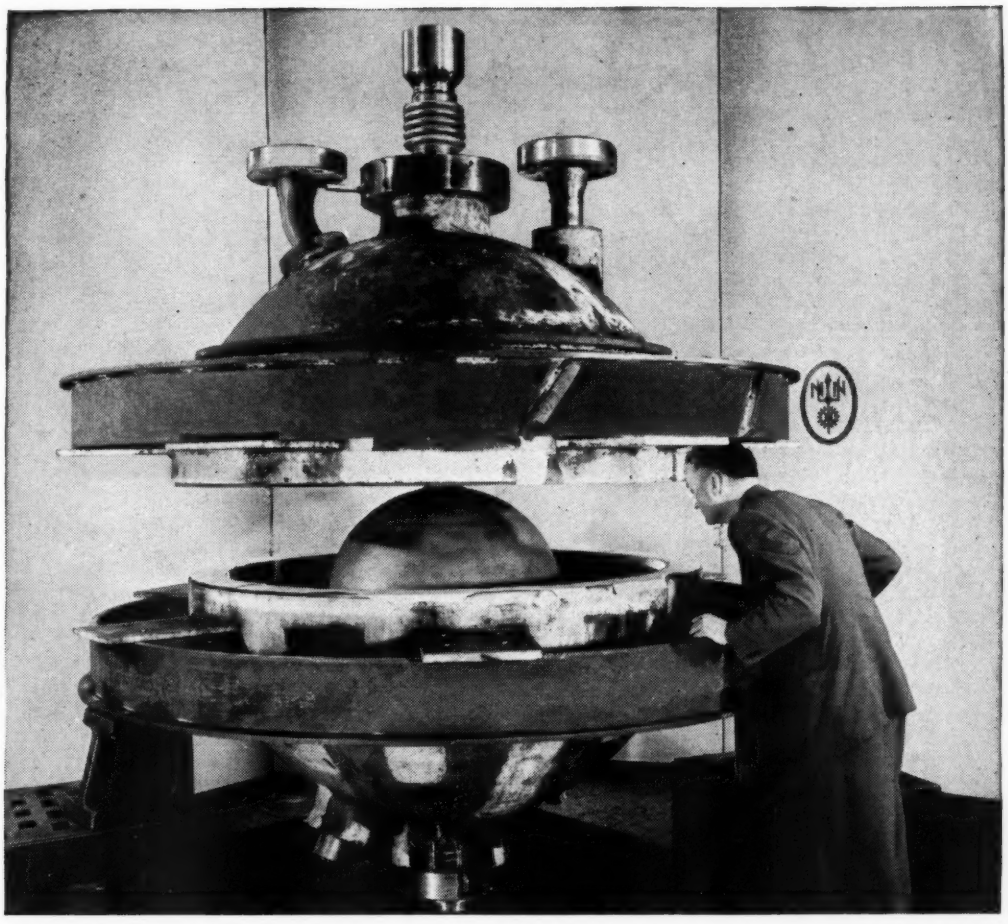
Dale H. Rea, Littleton, Colo.
Englewood water treatment plant, Englewood, Colo. Addition of two pairs of filter beds increasing the plant capacity by 50 percent to 21 mgd. Also alteration to clear water and raw water pumping stations to increase capacities. $168,000. Client, City of Englewood, Colo.

Water transmission line, pumping stations, and distribution system consisting of 3300 ft of 24 in. O.D. 3/16 and 1/4 in. plate; 16,500 ft of 18 in. O.D. 3/16 in. plate; and 6500 ft of 14 in. O.D. 3/16 in. plate; steel water transmission pipeline and two concrete vault type pumping stations, and water distribution system. Located adjacent to and south of Englewood in Arapahoe County. $375,000. Client, Southeast Englewood Water District.

Larkin & Associates, Kansas City, Mo. Two neighborhood pools 42 x 82 ft. $130,000. Client, City of Denver, Colo.

Ramsey and Reeves, Denver, Colo.
Office, maintenance, and distribution building for Rocky Mountain area of G-E X-ray department. Steel frame, air conditioning, luminous ceiling. Denver, Colo. $180,000. Client, G-E X-ray Department.

Ib Falk Jorgensen, Denver, Colo.
Animal examination building, Colorado A&M, Ft. Collins, Colo. $700,000. Client,



Assembly of zircaloy-2 core tank and pressure vessel for Homogeneous Reactor Experiment No. 2 (HRE-2). The HRE-2 is a 5,000 KW plant designed for AEC by Union Carbide Nuclear Company. Newport News manufactured the 32" I.D. core vessel from 5/16" zircaloy-2, which involved the development of new welding techniques. The pressure vessel of Type 347 stainless clad steel is 4.4" thick, with an inner diameter of 60". Newport News designed the expansion joint between inner and outer vessels, and also produced the unusual coil-cooled blast shield for the unit.

Zircaloy-2 vessel produced by Newport News...for first two-region breeding homogeneous reactor

Never before had a pressure vessel been constructed from zircaloy-2.

Extremely active chemically, particularly at elevated temperatures, this alloy challenged fabrication. Unshielded, heated zircaloy absorbs atmospheric gases in quantities that render its corrosion and physical properties unsatisfactory. Newport News, however, achieved consistent, satisfactory welds by use of inert gas and novel, plant-developed shielding.

The core tank contains the fuel region where fissioning produces heat. The blanket or reflector region around the tank is confined by a pressure vessel of stainless clad steel.

Newport News, working with its suppliers, developed special fabrication and welding techniques, as well as forge and rolling methods to produce plates and forgings with required corrosion, nuclear and physical properties for both vessels.

Make Newport News your source for fabricated metal structures. See how this company's high integration of skill and facilities can help you. Our illustrated booklet, *"Facilities and Products"*, is yours for the asking. Write for your copy now.

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Designed to do the tough jobs in Chemical Processing and Storage

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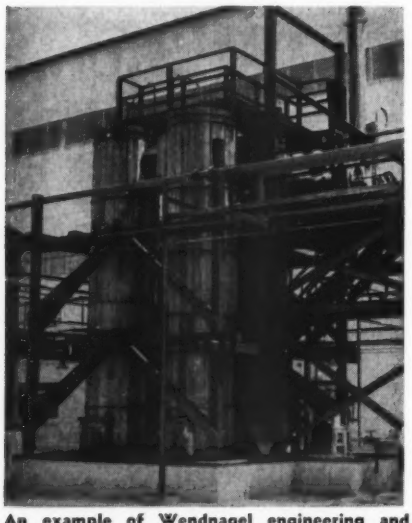

An example of Wendnagel engineering and construction for special applications—Multi-Stage Gas Scrubber for elimination of acid vapors and gases—furnished to requirements.

Single Stage Gas Scrubber—built to requirements. Regardless of the size of a Wood Tank required for your processing—Wendnagel can design and build it for you.

Let Wendnagel Engineers recommend the best type of construction for your particular application. Send details for our solution or write for chemical equipment bulletin.

Wendnagel & Co., Inc.

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James K. Hunter, Arch., Boulder, Colo.

Music building, Colorado A&M. $70,000. Client, James K. Hunter, Architect.

National Seed Storage Laboratory, Colorado A&M. $300,000. Client, James K. Hunter, Architect.

Men's and Women's dormitories, Adam State College, Alamosa, Colo. $500,000. Client, T. Wilson, Arch., Alamosa, Colo.

CONNECTICUT

Samuel W. Hoyt, Jr., Co., Inc., South Norwalk, Conn.
New roadways, storm drains, and parking areas at Municipal Calf Pasture, Beach Park. $250,000. Client, City of Norwalk, Conn.

Concrete slab highway bridge and upstream channel widening and deepening. Stony Brook, Darien, Conn. $50,000. Client, Town of Darien, Conn.

Flood control work on Betts Brook, Norwalk, Conn., including enlargement of existing road culverts and improvements of brook bed. $150,000 (est.) Client, City of Norwalk, Conn.

Sewage lift stations. $50,000 (est.) Client, City of Norwalk, Conn.

John H. Cassidy, Bridgeport, Conn.
8-story addition to the Bridgeport Hospital, Bridgeport, Conn. Steel frame, high strength bolts, lightweight concrete slabs. $3,500,000. Client, C. W. Walker, Architect.

Two 4-story girls' dormitory buildings and a dining hall and kitchen building. Reinforced concrete frame with slab and beam floor construction. University of Bridgeport, Bridgeport, Conn. $1,300,000. Client, C. W. Walker, Architect.

Three-story library, State Teachers College, New Britain, Conn. Reinforced concrete frame with two-way slab and flat concrete beams. $1,200,000. Client, Toby Vece, Architect.

One-story, 28-classroom school, with cafeteria and stage, for town of Danbury, Conn. Part steel frame, part wall bearing, steel joist, and precast roof plank. $1,200,000. Client, W. W. Sunderland, Architect.

Hill and Harrigan, New Haven, Conn.
Pitney-Bowes Corp., Stamford, Conn. Heating, ventilating, plumbing, and air conditioning ($900,000), new 138 kv power distribution system and interior wiring and communications ($700,000). Client, Leo F. Cuproni, Architect.

DISTRICT OF COLUMBIA

General Engineering Associates, Washington, D. C.
340-unit Capehart Housing Project, K. I. Sawyer AFB. Mechanical and electrical including electrical distribution system. $5,700,000. Client, McGaughan & Johnson, Architect-Engineers.

Office building, Washington, D. C. 3-story. Mechanical and electrical. $300,000. Client, Edwin Weihe, Architect.

126-unit luxury apartments, Washington, D. C. Mechanical, electrical, and structural. $1,500,000. Client, Corning & Moore, Architects.

FLORIDA

Charles T. Healy, Tampa, Fla.
Medical office building, seven stories, completely air conditioned. $500,000. Client, Mark Hampton, Architect.

Addition to St. Joseph's Hospital. 80,000 sq ft, consisting of new laboratories, central supply, service wing, and patients' beds. $1,000,000. Client, William Harvard, Architect.

Gerald J. Spolter, Miami Beach, Fla.
Cooperative apartment building. 7-story, reinforced concrete structure on pile foundation. Hollywood, Fla. $700,000. Client, Louis Wolff, Architect, Ft. Lauderdale, Fla.

C. T. Baker, Atlanta, Ga.
Strawberry freezing and storage plant addition to existing ice and cold storage plant. Freezing capacity 30,000 lbs per day at minus 30 F. Storage room 80 x 80 x 25 ft. Masonry construction. $100,000. Client, Arctic Ice Co., Plant City, Fla.

Lakeland Engineering Associates, Lakeland, Fla.
Construction of new triple super phosphate storage warehouse. Girders 101 ft 6 in. long with height of 12 ft at center tapering to 4 ft at ends. Width of top slab, 3 ft. Client, American Cyanamid, Brewster, Fla.

Jules P. Channing, Miami, Fla.
Factory, 80 x 160 ft with additional area of 35 x 51 ft for office space, Miami, Fla. Client, James Steel and Tube Co., Madison Heights, Mich.

Larkin & Associates, Kansas City, Mo.
Robert Meyer Hotel, Jacksonville, Fla. $5,200,000. Client, William Tabler.

IDAHO

Carroll F. Wilcomb, Jerome, Idaho.
Local Improvement District, sidewalk, curb, and gutter. N.E. quarter, Jerome Townsite. $145,000 (est.) Client, City of Jerome.

Cornell, Howland, Hayes & Merryfield, Corvallis, Ore.
Design of dormitory for airmen, recreation gymnasium, recreation swimming pool, and utility extensions. Mt. Home Air Force Base, Idaho. $1,435,000. Client, Corps of Engineers.

ILLINOIS

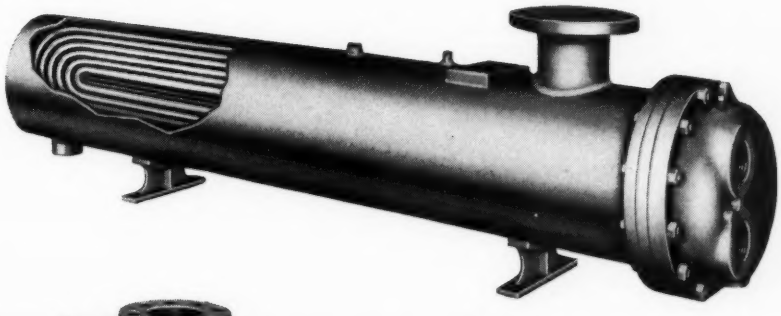
Skidmore, Owings & Merrill, Chicago.
Prepare over-all master plan for eventual research center and design initial laboratory structure to be erected in near future. Des Plaines, Ill. Client, Celotex Corp.

Russell & Axon, St. Louis, Mo.

Specify WHITLOCK WATER HEATERS for every service

STORAGE Whitlock Type K Storage Heaters provide adequate supplies of hot water at all times. Everdur construction assures lifetime service: made also in Eterno and Standard Steel. A wide range of sizes for every requirement. Bulletin 40B.

INSTANTANEOUS Whitlock Type R Instantaneous Heaters are used where hot water at a nearly uniform rate is desired. The U-tube bundle is removable. Other designs also available. Bulletin 20A.



CONVERTORS Whitlock Type R Convertors are widely used for space heating systems in all types of buildings. The two-pass design furnishes hot water with minimum pressure drop. Made in a full range of sizes, for typical pressure. Bulletin 62.

Designing and manufacturing water heaters for thousands of installations gives us a background as hot water specialists which can be useful to you when you're selecting and specifying such equipment. Whitlock Water Heaters are widely used in hospitals, laundries, mills, hotels, schools, and industrial plants . . . large and small . . . where their record of performance is outstanding. We have standardized heaters ideally suited for the majority of applications, and also design and build water heaters to meet special needs. We will gladly assist you with any water heating problems . . . ask us for suggestions when you're specifying your next job.

The Whitlock Manufacturing Co., 96 South Street, West Hartford 10, Conn. New York, Philadelphia, Boston, Detroit, Chicago, Richmond. Authorized representatives in other principal cities. In Canada: Darling Brothers, Ltd., Montreal.

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WHITLOCK Designs and builds: bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.

THE WHITLOCK MFG. CO., West Hartford 10, Conn.

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☐ Convertors Bulletin 62

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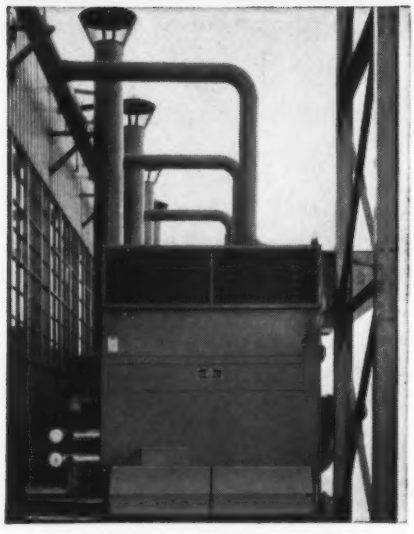

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● Save the cost of cooling water and you save the price of the Niagara Aero After Cooler (for compressed air or gas) in less than two years.

Extra, for no cost, you get drier compressed gas or air for your process. You get better operation and lower costs in the use of all air-operated instruments, machines, or paint sprays. You save expense for piping, pumping, water treatment and disposal. You get the use of badly needed water elsewhere in your plant.

Niagara Aero After Cooler cools compressed air or gas (evaporatively) below the temperature of surrounding atmosphere, with no further condensation in your air lines.

Write for complete information; ask for Bulletin No. 98, or contact nearest Niagara Engineer if you have any problem involving the industrial use of air. Address Dept. C.O.

NIAGARA BLOWER COMPANY
405 Lexington Ave., New York 17, N.Y.
District Engineers
in Principal Cities of U. S. and Canada

Waterworks improvement. Elevated tank and main extensions. Plans in progress. $60,000. Client, Ziegeler, Ill.

INDIANA

W. H. Junker & W. C. Pistler, Associated Engineers, Cincinnati, Ohio. Mechanical and electrical equipment for new building of Congregation Beth-El Zedeck, Indianapolis, Ind. $400,000. Client, McGuire & Shook, Architects, Indianapolis, Ind.

Jos. Rakowski, E. Chicago, Ind. Preparation of plans and specifications and supervision of construction for elementary public school. $1,400,000. Client, School Board, City of East Chicago.

IOWA

Larkin & Associates, Kansas City, Mo. Municipal pool. $150,000. Client, City of West Des Moines, Iowa.

KANSAS

Larkin & Associates, Kansas City, Mo. Municipal pool. $80,000. Client, Westlink Improvement District, Wichita.

Sewage treatment plant. $130,000. Client, City of Burlington, Kans.

Swimming pool. $180,000. Client, City of Lawrence, Kans.

Swimming pool. $135,000. Client, City of Independence, Kans.

MICHIGAN

The Francis Engineering Co., Saginaw. Preliminary plans for new Bristol Street Bridge, spanning Saginaw River. $1,589,500. Client, City of Saginaw, Mich.

Waterworks system for Thomas Township, Saginaw County, Mich. $536,000 (L&M Dist. System only). Client, Thomas Township, Saginaw County.

Proposed sewerage system consisting of sanitary sewers and sewage treatment plant. $460,000. Client, Village of New Haven, Mich.

Preliminary plans for a sewage treatment plant and sanitary sewer system. Client, City of Memphis, Mich.

Garrity & Mosher, Detroit, Mich. Wayne County, Mich., water supply project, transmission main design. $10 million. Client, Board of County Road Commissioners.

G. L. McLravy & Sons, Lansing, Mich. Bridge and approaches, Third Avenue over Flint River, Flint, Mich. $275,000. Client, City of Flint, Mich.

Bridge and approaches, Logan Street crossing the Grand River and N.Y.C.RR spur track. Extension of Logan Street north to U.S. 16. $500,000. Client, City of Lansing, Mich.

Stuart D. Long, Grand Rapids, Mich. Student Center, Ferris Institute, Big Rapids, Mich. Building devoted entirely to student extra curricular activities consisting of ballroom, food services, recreation rooms, lounges, and student offices. Full ventilation with option to cool. $500,000. Client, Roger Allen & Associates, Architects.

General office building. Fully air conditioned, two-story building with provisions for third floor. $200,000. Client, L. A. and J. D. Boland, Brice McMillen, Architects.

Pate & Hirn, Detroit, Mich. 4 million gal concrete water reservoir, 1 water pumping station, 12 mgd, 1 water pumping station, 10 mgd, transmission mains. $650,000. Client, City of Oak Park, Mich.

MINNESOTA

Irving S. Towsley, Philadelphia, Pa. One-story plastics and capseal plant. Structural frame, brick exterior walls with limestone trim, precast concrete roof deck. 105,000 sq ft total area, including 12,000 sq ft office and laboratory space. Client, Minnesota Mining & Manufacturing Co., St. Paul, Minn.

J. A. Lindsey, Minneapolis, Minn. Sewage treatment lagoons and outfall sewer. $60,000. Client, Village of St. Michael, Minn.

Toltz, King, Duvall, Anderson & Associates, St. Paul, Minn. Sixth Street Bridge, St. Paul, Minn. $2,500,000. Client, Minnesota Highway Department.

Battle Creek trunk sewer, St. Paul. $2,000,000. Client, City of St. Paul.

Sanitary sewer system, Falcon Heights, Minn. $750,000. Client, Village of Falcon Heights, Minn.

Sewage treatment plant improvements, Fergus Falls, Minn. $400,000. Client, City of Fergus Falls, Minn.

Jack D. Salo, Inc., Duluth, Minn. Water main extensions, booster pumps, pressure tank, and buildings. $35,000. Client, Village of Orr, Minn.

Water mains, water intake, pump station, elevated storage tank, and buildings. $150,000. Client, Village of Beaver Bay, Minn.

Sewage disposal plant and treatment. $70,000. Client, Village of Cook, Minn.

MISSISSIPPI

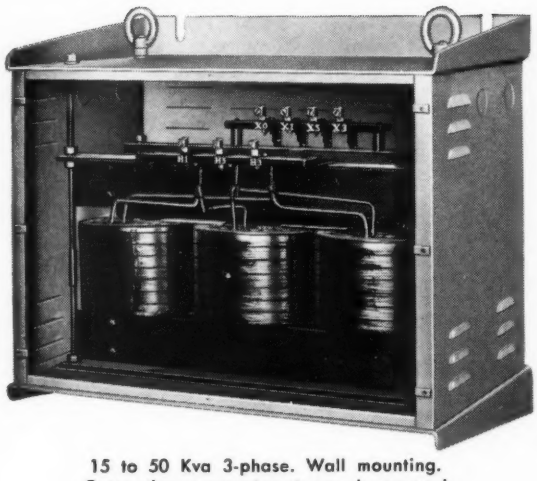
James A. Evans, Birmingham, Ala. Air conditioning, ventilation, heating, and plumbing for Southern Bell Tel. & Tel. Co. New 6-story building, Jackson, Miss. $2,000,000 (est.) Client, Warren, Knight & Davis, Architects.

MISSOURI

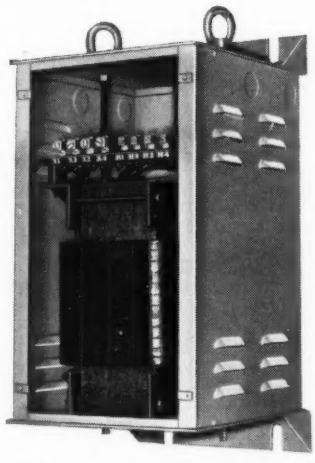
Larkin & Associates, Kansas City, Mo. Studies for sewage treatment plant, trunk sewers and sewer extensions. Client, City of Macon, Mo.

SORGEL dry-type transformers are *really different!*

They are not just ordinary transformers



15 to 50 Kva 3-phase. Wall mounting.
Connection compartment panel removed



20 to 75 Kva single phase. Wall mounting.
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SORGEL TRANSFORMERS

Compare and check these features:

QUIET OPERATION — The sound level of SORGEL dry-type transformers is well below the established standards. Therefore they are adaptable for any indoor installations, including those structures where sound levels are an important factor.

HIGH EFFICIENCY — SORGEL dry-type transformers are designed to carry the full rated load at high efficiency.

SAFE TEMPERATURE — SORGEL dry-type transformers have a safe operating temperature.

EASY INSTALLATION — Wall brackets or floor mounting bases are an integral part of SORGEL dry-type transformers. All are equipped with solderless terminal lugs. Terminal board for the larger ratings.

UNDERWRITERS' APPROVED in all the ratings covered by the Re-examination Service, both single phase and 3-phase. They also meet or exceed the requirements of ASA, AIEE, and NEMA standards.

LONG LIFE — Thermo-vacuum impregnated windings brazed to solderless terminals assure years of trouble-free service.

Available in all standard and intermediate ratings and voltages — ¼ to 3000 Kva up to 15000 volts.

SUBSTATIONS—SORGEL transformers, either dry-type or Askarel-cooled, are incorporated in substations, complete with primary or secondary switchgear. They are procurable with any make of switchgear, and from any substation manufacturer.

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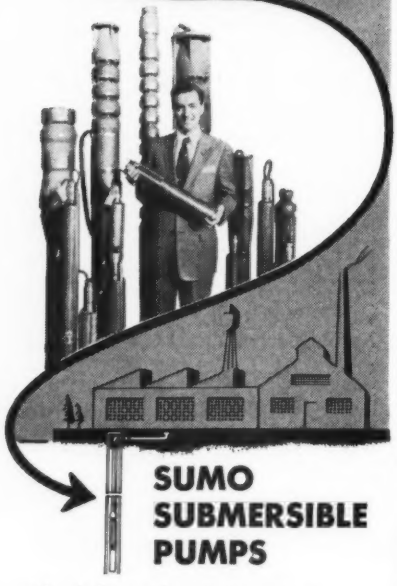
and what a job they do for deep well water supply!



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Ideal for school, hospital, apartment, theater, office building, factory water-supply and air conditioning.

Here's the last word in deep well pumps — the SUMO SUBMERSIBLE is a high capacity, high performance pump that's completely noiseless, completely dependable, completely adaptable to any well.

Developed for continuous underwater operation — the entire unit — including the motor — operates inside the well under water. There are no suction troubles — no worries about freezing or floods — no pump house to build. The entire installation is neat, compact and quiet — and, in view of the absence of long drive-shafts — remarkably efficient.

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Sewerage works improvements. $400,000. Client, City of Macon, Mo.

Williamson & Associates, St. Louis, Mo.
Improvements to municipal water treatment and softening plant. $231,000. Client, City of Perryville, Mo.

Main trunk and interceptor sanitary sewer system for North Affton Sewer District, St. Louis County. $240,000. Client, Metropolitan St. Louis Sewer Dist.

New municipal water works system. $90,000. Client, City of Essex, Mo.

MONTANA

Engineering Service Corp., Los Angeles, Calif.
Photogrammetry, 830 miles of interstate highway. $300,000. Client, State of Montana, Highway Commission, Helena, Mont.

NEW JERSEY

Andre H. Vanderzanden, River Edge, N. J.
One-story warehouse with shipping facilities, including rail siding. Construction: structural steel and timber framing, masonry walls and partitions, precast roof deck. 55,000 sq ft. Clifton, N. J. $300,000. Client, Allwood Assoc.

One-story addition to toy factory including truck unloading dock. Construction: timber framing, precast roof deck, cemesto walls. 3000 sq ft, Norwood. $25,000. Client, Colorforms, Inc.

H. G. Metzger, Jr. & Associates, Huntingdon Valley, Pa.
Heating, cooling, and plumbing services. Faith Tabernacle, United Holiness Church of America, Bordentown, N. J. $85,000. Client, Franklyn B. Spiezle, Architect, Trenton, N. J.

NEW YORK

Charles C. Burton, Upper Montclair, N. J.
Modern, 6-story, air conditioned office building. $1,200,000. Client, Sage Construction Co., New York, N. Y.

Burns and Roe, Inc., New York, N. Y.
Design and supervision of construction of facilities to house electronic equipment for Semi-Automatic Ground Environment (SAGE) air defense system. Client, Rand Corporation.

Herman Kron, New York City.
Erection of 1-story brick building to be used for automatic car wash in conjunction with gasoline service station. New Hyde Park, L. I., N. Y. $20,000. Client, Benjamin Israel.

NORTH CAROLINA

John R. Gove, Engineer, Hendersonville, N. C.
4 mgd raw water booster pump station, Hendersonville, N. C. $75,000. Client, Board of Water Commissioners.

Reinforced brick swimming pool, 30 x 65 ft, Hendersonville, N. C. $25,000. Client, Hendersonville Country Club.

OHIO

Pistler and Pistler, Cincinnati, Ohio.
Greenfield municipal light plant, Greenfield, Ohio. $1,000,000. Client, Board of Public Affairs.

Bird and Tietzel, Columbus, Ohio.
Intercepting sewers and sewage treatment plant. $200,000. Client, Village of Brilliant, Ohio.

Sewage treatment plant additions. $400,000. Client, City of Washington Court House, Ohio.

PENNSYLVANIA

Roushey and Smith, Wilkes-Barre, Pa.
New boiler plant and buildings renovation. $350,000. Client, Wilkes-Barre City School District.

Conversion of textile manufacturing plant to cigar manufacturing. $400,000. Client, Consolidated Cigar Corp.

SOUTH CAROLINA

Merrill & Mann, Memphis, Tenn.
Dormitory, Wofford College, Spartanburg, S. C. $350,000. Client, Wofford College.

J. E. Sirrine Co., Greenville, S. C.
Two-and-three-story paper mill, 620 x 100 ft. Outside walls of brick with aluminum siding and horizontal separating panels of plastic to admit light. Pile type foundation. $1,000,000. Client, P. H. Glatfelter Co.

TENNESSEE

H. T. Spoden, Kingsport, Tenn.
Prestressed concrete bridge. 450 ft total, 2 spans 85 ft, 2 spans 90 ft, one span 100 ft over South Fork of Holston River. $161,692. Client, Ridgefields, Inc.

Merrill & Mann, Memphis, Tenn.
Distribution center for wholesale company, Memphis, Tenn. $2,500,000. Client, Ely Walker Co.

10-story addition to Methodist Hospital, Memphis, Tenn. $3,500,000. Client, Methodist Hospital Trustees.

Gym for Catholic High School, Memphis, Tenn. $300,000. Client, Catholic. Public Schools. $2,000,000 (total).

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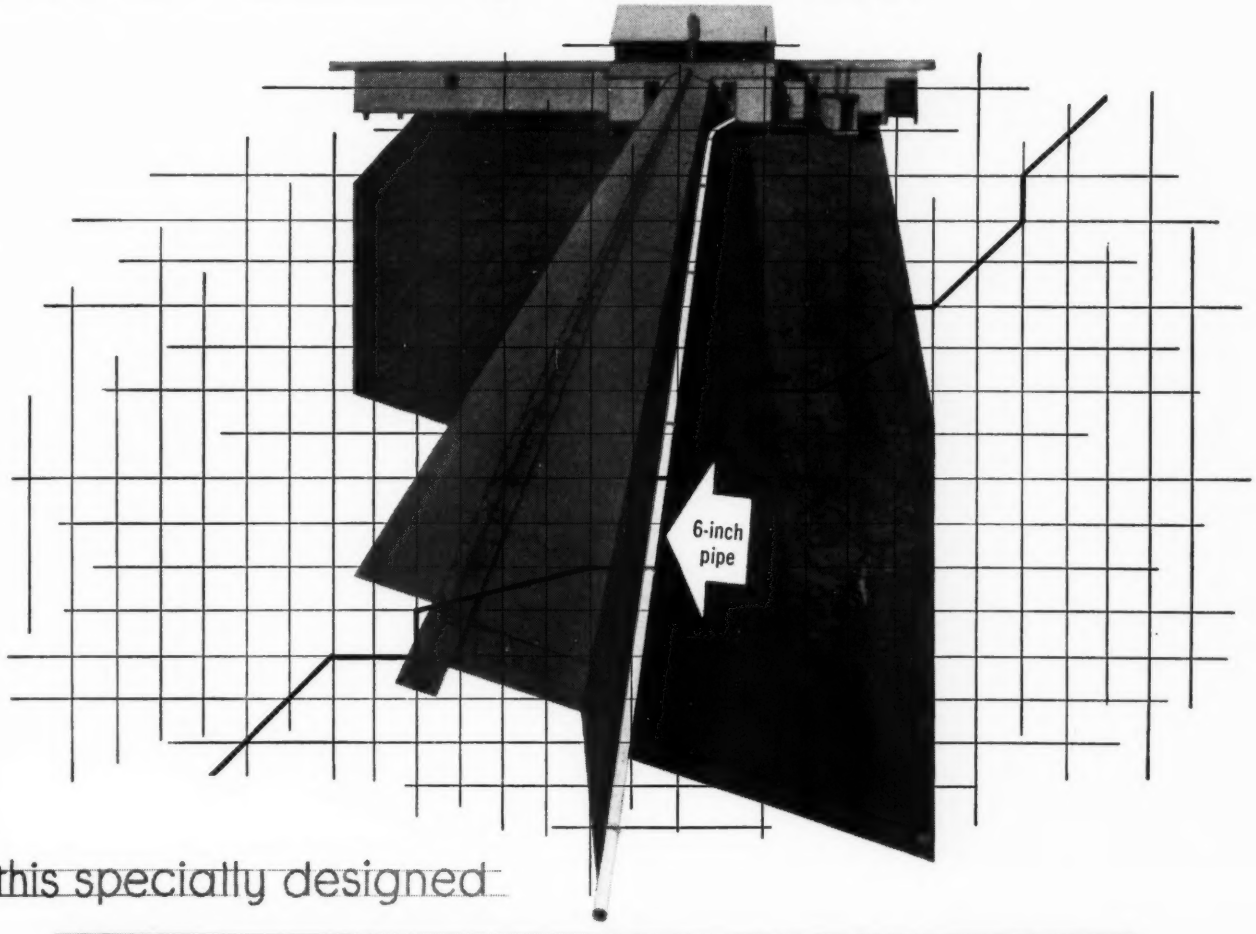

this specially designed

HOFFMAN PNEUMATIC CONVEYING SYSTEM

improved safety and cut costs in transporting **TNT!**

In this arsenal TNT has to be taken from the box-opening and screening building to another building approximately 500 feet away for melting.

The old system: A powered screen discharged TNT into wheeled buggies that were pushed by hand along the 8-foot enclosed ramp shown above. At the other end, each buggy was taken up to the third floor, in one of two freight elevators, and the TNT was fed to the melting equipment.

The new system: TNT is conveyed directly from screening to melting through a 6-inch pipe, at a rate up to 200 pounds per minute, although no more than one 50-pound increment is being conveyed through the pipe at any given time. No handling. No buggies. No elevators.

Results: (1) Hoffman furnished a double damper valve that handles the TNT safely and automatically meters its flow. (2) The control of the interrupted stream of conveyed explosives maintains the safe separation of different operations. (3) The pneumatic system paid for itself in the first 18-months' labor saving.

In new construction, the elimination of the ramp and freight elevators would more than pay for the pneumatic conveyor, disregarding the labor savings involved. This is usually the case, comparing Hoffman pneumatic systems with other material handling methods.

Consider how much **you** can save moving material pneumatically. Your letter will bring more information or the services of a trained representative, without cost or obligation.

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. . . the practical alternate hot-applied coal tar coating in handy tape form

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This practical solution assures the protection required without the need for tar kettles, technical know-how and special crews. Field application costs are reduced because TAPECOAT is so easy to apply, using a torch to soften or bleed the pitch and then spirally wrapping it on the vulnerable surface.

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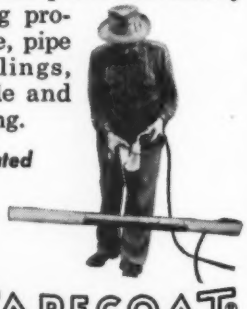

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Books

For

Consulting Engineers

AMERICAN CIVIL ENGINEERING PRACTICE, Vol. I, Edited by Robert W. Abbett; John Wiley & Sons, Inc.; 1020 pp.; $15.00.

Reviewed by
Liberato Daniel D'Addona
McNamee, Porter and Seeley

This book is the first of three volumes dealing with the field of civil engineering. Volume I contains 11 sections each written by one or more recognized authorities in that field. The list of contributors contains the names of some of America's most distinguished engineers. All three volumes are edited by Robert W. Abbett, who is an associate of the engineering firm of Tippetts-Abbett-McCarthy-Stratton, Engineers. These volumes replace the *American Civil Engineers Handbook*, which was first published in 1910. For consulting engineering libraries these books are a must.

Volume I is a reference source for civil engineers in all fields. Emphasis has been placed upon the planning aspects of civil engineering as well as technical design and construction. Each section is indexed and well written.

The first of 11 sections, Metropolitan and Community Planning, covers all the factors involved in the planning of a community, such as: the economic base; population growth, distribution, and composition; land use; planning objectives of new areas; and long range financial planning. Municipal engineers and consulting engineers that do municipal work will find this section very valuable.

Section 2, Surveying, is a very complete reference of the surveying field.

Section 3, Traffic Engineering, covers the general field of traffic engineering with emphasis on planning and functional design of highways, and also parking problems.

Sections 4, 5, and 6, Highway, Airport, and Railroad Engineering, deal with location, design, construction, and maintenance of highways, airports, and railroads.

Section 7, Soil Mechanics and Site Examination, covers soil classification and laboratory and field tests. It also discusses the problems of slope stability, foundation settlement, and earth pressure.

Section 10, Tunnels, discusses methods of tunneling for subways, railroads, and highways and shows many cross-sectional drawings of existing tunnels.

Section 11, Mathematical Tables, consists of 44 tables, calculus functions, and interest and discount tables.

Mr. Abbett deserves a note of thanks from civil engineers everywhere for a great contribution to the civil engineering field.

ALSO AVAILABLE

MATHEMATICS AND COMPUTERS, by George R. Stibitz and Jules A. Larrivee; McGraw-Hill Book Co., Inc.; 236 pp.; $5.00.

This book surveys the work of the applied mathematician, the problems he studies, the methods he uses — especially computational methods — and the computing devices that help him in the application of mathematics to problems in science, engineering, and business.

Computing devices and their components are described: their operation, capabilities, and limitations. Typical applications of computing devices in technology and business are included.

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"Fire Prevention Code," published by the National Board of Fire Underwriters, is a revised edition, brought up to date and made consistent with all the latest nationally recognized safety standards. It provides for safeguards against fire hazards and explosion from storage, handling, and use of flammable liquids and gases, hazardous chemicals and explosives, plastics, dusts, and fumigents. It also gives safeguards against conditions hazardous to life and property in the use or occupancy of buildings or premises, such as garages, bowling alleys, and places of assembly. Copies are available free of charge from the Na-

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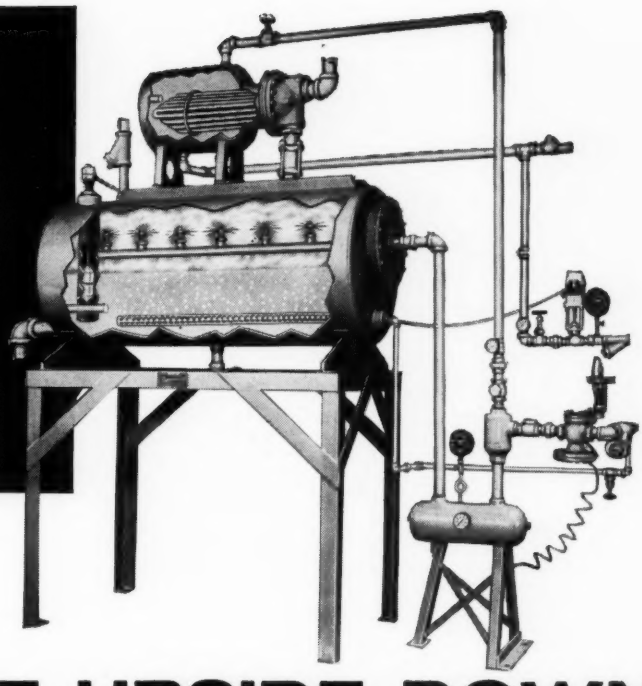

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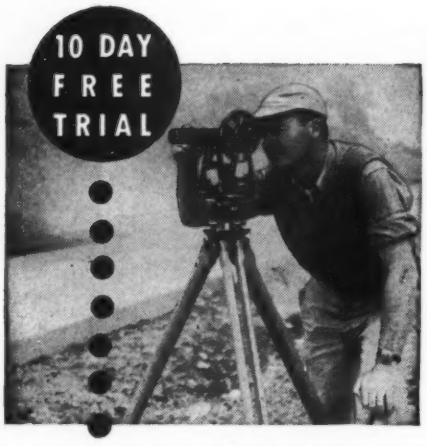

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1956 SUPPLEMENTS TO BOOK OF ASTM STANDARDS, 7 Parts; heavy paper covers; $4.00 per part, $28.00 per set.

These supplements give 420 specifications, tests, and definitions that were either issued for the first time in 1956 or revised since their appearance in the 1955 book.

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Part 7. "Textiles, Soap, Water, Paper, Adhesives, Shipping Containers, Atmospheric Analysis."

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THE DESIGN AND CONSTRUCTION OF ENGINEERING FOUNDATIONS, by F.D.C. Henry; McGraw-Hill Book Co., Inc.; 547 pp.; $9.00.

Written by a member of the Department of Civil Engineering, University of Leeds, the book explains such aspects of geology and soil mechanics as light foundations on clays, stability of slopes, flow of ground water, and permissible stresses in reinforced concrete slabs and beams. It then takes up the design and construction of individual footings, including steel column bases; plain mass concrete foundation blocks; and the problem of eccentrically loaded footings. Continuous footings and rafts are thoroughly treated, with various methods of analysis. In discussing retaining walls and culverts, the book supplies detailed examples of counterfort wall design, and arch section culvert design. Construction of cofferdams and caissons, and the problems of foundations in bad ground or under water, are explored in a helpful manner. Help is given for planning bridge abutments and piers, bearing piles and piling, and underpinning. The book provides practical guidance in constructing foundations for withstanding mining subsidence. In addition, it furnishes a reference covering the selection of foundation types, appropriate site investigation, and other frequently required information and data.

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"Recommended Practice for Winter Concreting," revised American Concrete Institute standard, is available as a paper-bound reprint for $ .75 ($ .50 to ACI members) from the Institute offices at 18263 West McNichols Rd., Detroit 19, Mich. ▲▲

Correct name of the author of *The Steel Skeleton, Vol. II,* reviewed in the October issue of CONSULTING ENGINEER, is J. F. Baker.

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